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The College is a Government institution, designed primarily for the purpose of giving the highest technical instructions in all branches of military science to cadets and officers of Canadian militia. In fact it is intended to take the place in Canada of the English Woolwich and Sandhurst and the American West Point.

The Commandant and military instructors are all officers on the active list of the Imperial army, lent for the purpose, and in addition there is a complete staff of professors for the civil subjects which form such a large proportion of the College course.

Whilst the College is organized on a strictly military basis the cadets receive in addition to their military studies a thoroughly practical, scientific and sound training in all subjects that are essential to a high and general modern education.

The course in mathematics is very complete and a thorough grounding is given in the subjects of Civil Engineering, Civil and Hydrographic Surveying, Physics, Chemistry, French and English.

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Apart from the timber lands, and already conceded areas, the Government has at its disposal for colonization purposes, between 6½ and 7 millions acres of land surveyed and subdivided, at prices which defy competition, namely fifty cents to twenty cents per acre. These townships are situated in all parts of the Province, from Lake Temiscamingue in Pontiac, to Gaspé Basin on the sea board, so the wants of everyone can be suited. In most cases the quality of the soil is well adapted for agricultural purposes, and particularly so in the Eastern townships, Metapedia Valley, the Upper Ottawa, and Lake St. John.

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SHEEP FEEDING

(EXTRACTS FROM BULLETIN)

BY

JOHN A. CRAIG

Professor of Animal Husbandry in the
University of Wisconsin

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In feeding all classes of sheep there are general details that contribute toward satisfactory results. Among these may be included all those things that are conducive to the general health of the sheep, such as considerate treatment, cleanliness of troughs and racks, healthfulness of the quarters in which the sheep are kept, regularity in feeding, and the use of such accessories as salt, pure water, and sulphur.

FEEDING BREEDING EWES.

To enter into detailed discussion of the feeding of breeding ewes it will be best to divide the topic according to the season, and in this way present the subject of winter, spring, summer and fall feeding. Under climatic conditions permitting the breeding flocks to have pasture throughout the year, what may be termed summer feeding would largely prevail at all times, so with such an understanding local conditions will not necessitate much variation from the course of feeding suggested.

WINTER FEEDING OF BREEDING EWES.

Breeding ewes require 10 to 15 square feet of space in a building, and ewes weighing from 150 to 200 pounds should have an allowance of 1.5 feet at the feeding rack. Less than this causes too much crowding at feeding time, which often results in the birth of dead lambs.

Breeding ewes need not be fed more than twice daily. It is a good practice, however, to feed them some fodder outside during the winter season, for in this way they are induced to take some exercise. With this in view the fodder may be taken some distance from the building in which the sheep are housed.

In a practical way, the shepherd should regulate the quantity of food according to the condition of the ewes. If they have gone into winter quarters in thin condition, they should be fed more heavily than if they were fat at that time. Handling the ewes at intervals furnishes the best indication as to their condition, and this will indicate the quantity of food that should be fed. In the author's experience the aim has always been to keep the breeding flocks in a condition which the general farmer would term "fat," and only good results in lambs have come from this management. When ewes are firm fleshed, through abundant feed and exercise, they are vigorous, and a healthy flock of lambs is likely to be the outcome. In general, a breeding ewe weighing 150 pounds requires daily about one-half pound of such grain as bran and oats, 2 pounds of succulent food, and the same weight of such dry fodder as clover hay or cut corn fodder. As lambing time approaches, twice this amount of grain will be required. The quality of the fodder and grain will have an influence on the amounts to be fed, but the controlling factor should be the condition of the ewes. Overfeeding, especially if associated with lack of exercise, will be productive of disease in the flock, and it is likely to result in the birth of large weak lambs, while underfeeding is equally favorable for disease and the birth of undersized lambs. Overfeeding may produce sterility, while underfeeding delays the

breeding season. The vigorous, firm-fleshed condition which results from liberal feeding and unlimited exercise, is the aim of the experienced flock master.

Coarse Fodders.—Among the fodders for winter feeding may be mentioned clover hay, pea straw, corn fodder, oat hay, oat straw, and millet. As to their relative merits, based on cost, the nourishment in them for sheep and more especially the preference of the sheep for them are about in the order given.

At the Wisconsin Station 6 lots of Shropshire breeding ewes, with 4 ewes in each lot, were fed one-half pound of bran or oats and from 2.5 to 3.1 pounds of succulent food per head daily. In addition to this each lot received its distinctive coarse fodder, consisting of either alsike clover hay, corn fodder cut into inch lengths, cut or uncut oat hay, oat straw, or blue-grass hay. The sheep were very fond of the fine, well-cured alsike clover hay, and left only 16 per cent. as refuse. Each ewe ate daily 2 pounds of alsike clover, 2.8 pounds of corn silage with 0.5 pound of oats and bran daily, which at the customary prices cost 1.5 cents. The ewes averaged 177.2 pounds in weight at the beginning and 196.2 pounds at the end of the experiment.

The ewes on the cut corn fodder (ears removed) ate 1.75 pounds of corn fodder, 3.1 pounds of sugar beets, and 0.5 pound of oats or bran daily, costing 1 cent. Their weight at the beginning averaged 152.4 pounds and at the end 163 pounds. The refuse, consisting mostly of the thick parts of the stalks, was 20 per cent. We have fed corn fodder extensively, and the sheep seem to like it and thrive well on it.

The ewes on uncut oat hay ate 2.1 pounds of the hay, 2.5 pounds of corn silage, and 0.5 pound oats or bran costing 1.2 cents. They averaged 175.6 pounds in weight at the beginning and 194.7 pounds at the end. The refuse was 32 per cent. The lot receiving the cut oat hay ate 1.5 pounds cut oat hay, 2.4 pounds of corn silage, and 0.5 pound oats or bran, costing 1.2 cents. They averaged 177.3 pounds at the beginning and 182 pounds at the end of the trial. The refuse amounted to 35 per cent. No advantage was gained in cutting the oat hay, and one of the objections to it was that the small pieces of straw would get into the neck wool, cause it to mat, and, in some instances, drop away. The oats were cut when green, the kernel being just filled.

The lot on oat straw ate 1.1 pounds of this daily, together with 3.1 pounds of sugar beets, and 0.5 pound of oats or bran, costing 0.8 cent. They averaged 155.5 pounds at the beginning and 156.5 pounds at the end of the experiment. The refuse was 22 per cent. When supplemented with the proper amount of grain and succulent food, oat straw may be utilized for maintaining breeding ewes, but it is best to have other fodder to feed at intervals.

The ewes receiving blue-grass hay ate 1.5 pounds of the hay, 3.1 pounds of sugar beets, and 0.5 pound of oats or bran, costing 1.3 cents. They averaged 148.2 pounds in weight at the beginning and 153 pounds at the end of the trial. The refuse was 6.2 per cent. The sheep apparently were not fond of this hay, although the grass is eagerly eaten as it grows in the pasture.

Pea straw is greatly relished by sheep, and in nutritive value it leads all the other fodders mentioned, with the exception of the clover. In Canada, where the pea crop is a general one, the straw is put away especially for the sheep, and it is fed more extensively, perhaps, than any other fodder, with good results.

The hardness of the stems of timothy hay seems to be one of the reasons why sheep do not care much for this fodder. They never appear to be eager for it, and if given any latitude in choice they will leave it untouched in favor of any of the other fodders, with the possible exception of oat straw.

Grains.—For the best results in thrift, wool growth, and lamb production, the breeding ewes should get some grain during the winter season. They can hardly be kept in proper condition otherwise. A good plan is to feed oats the first part of the winter, and then bran as lambing time approaches. About 0.5 pound of oats during the first of the winter and near lambing time 1 pound of bran per head daily will be sufficient for breeding ewes weighing from 150 to 200 pounds. These are the two most satisfactory grain foods that are gen-

erally available, both in respect to cost and results. Corn is not a satisfactory grain to feed ewes, as it produces too much fat, which apparently tends to accumulate internally and impair breeding qualities and lessen the general vigor, instead of imparting tone to the system.

Succulent Foods.—Some succulent food should be fed to breeding ewes at all times, though it is very easy to feed them too much just previous to lambing. When turnips or silage are fed to breeding ewes in too liberal quantities, weak lambs are likely to result. Before lambing, 3 pounds of any succulent food, such as mangel-wurzels, sugar beets, corn or clover silage, will be found sufficient. After lambing, unlimited quantities of these may be fed, to stimulate the milk flow.

Turnips are relished by the sheep, and the author prefers them for sheep feeding to any other roots. Sheep are very fond of any of the varieties of Swedish turnips, and also relish mangel-wurzels near springtime. Sugar beets are satisfactory if fed in small quantities. In our trials we have found that a ewe would eat daily 3.3 pounds of sugar beets, with 1.5 pounds of hay and 0.5 pound of oats or bran, costing about 1.3 cents. The ewes that were fed this ration averaged from 150 to 160 pounds.

Corn or clover silage, when well preserved, is a succulent food that may be fed to sheep with satisfactory results. It is cheap, is liked by the sheep, and if fed in quantities not exceeding 3 or 4 pounds per head daily it will give satisfaction. The corn kernels in the silage are one of the drawbacks to feeding it liberally. In our trial with corn silage it was found that ewes weighing about 150 pounds ate daily 2.2 pounds of the silage, 1.5 pounds of hay, and 0.5 pound of oats or bran, costing 1.1 cents. Ewes of similar weight receiving clover silage ate 2.6 pounds clover silage, 1.5 pounds of hay, and pound of oats and bran, costing 1.2 cents. They gained more on the clover silage. The refuse from the corn silage was 6 per cent. of all that was fed, and from the clover silage nearly 13 per cent.

As to the relative effects of silage and roots on the milk flow, the experiments at the Wisconsin Station were without very decided results. At the New York Cornell Station this feature was studied more fully. As between mangel-wurzels and corn silage, the lambs sucking the ewes fed roots made slightly better gains than those sucking ewes fed silage, although the silage appeared to be the cheaper ration. As between beets and corn silage, the lambs of the ewes fed silage made slightly the larger gain in weight. These results show but a meager difference in the feeding value of these foods.

SPRING FEEDING OF BREEDING EWES.

If the ewes lamb before the conditions are such that they may be turned out to pasture, they will require liberal feeding, which means about 1 to 1.5 pounds of bran, 2 pounds of hay, and as much succulent food as they will eat. It is very desirable to maintain a heavy flow of milk, and to do this, grain feeding and the free use of succulent food are necessary while the sheep remain in the sheds.

Pasturage.—It is generally good management to turn the ewes and lambs out to pasture as soon as possible, provided some grain is fed to the ewes while the grass is in a very succulent state. There is not sufficient nourishment in it at this time to properly support the ewes that are suckling lambs.

It is advisable to so stock the pastures with sheep that none of the grass may grow too coarse. On the other hand, overstocking injures the pasture and makes the conditions favorable for disease. Frequent change from one pasture to another will be found advisable.

Feeding grain to ewes on pasture.—When the pasture ceases to consist altogether of a fresh growth peculiar to an early spring, there is no advantage in feeding the ewes grain. In our experiments with 40 ewes and 56 lambs was found that the lambs did not make any greater gain when their dams were fed grain on good pasture. The only compensation for feeding grain to the ewes was in the fact that those receiving grain did not lose as much in flesh as the others. But this greater loss was easily made good again when ewes were put on rape or pasture after the lambs were weaned.

SUMMER FEEDING OF BREEDING EWES.

In the summer management of the breeding flock there is nothing of more importance than a provision of some green fodder to supplement the dry and parched pastures that are common in most sections in the summer months. For this purpose the crops most commonly utilized are rape, rye, corn, and vetches.

Rape.—This crop is one that has many advantages for summer feeding breeding ewes. It grows rapidly, produces a large quantity of succulent food, and is greatly relished by sheep. About two months is required for the growth of a crop. It remains fresh in the field for over a month under usual conditions after the first cutting has been made. At the Wisconsin Station 62 ewes, 26 ewe lambs, and 5 rams were fed from 300 to 350 pounds of rape daily throughout the drought of August and September. From August 16 until September 17, 9.75 tons by actual weight were cut from 0.5 acre, or at the rate of 19.5 tons per acre.

In cutting rape at different heights, the best results were obtained from cutting about 4 inches from the ground. Two cuttings were made from the piece so treated, one August 29 and the other November 6, and the yield was at the rate of 36 tons per acre.

Rye.—The writer has known a rye pasture to be in good condition after being used six years for pasturing sheep. The rye was never allowed to grow beyond the second joint of the stalk. If the sheep did not keep it down, it was cut. It furnished unusually early pasturage for sheep, and was at all times acceptable. Rye grows quickly, will establish itself in poor soil, and is eagerly eaten by sheep if it is not allowed to become rank. It may be used as a soiling crop at any time, but with special advantage if sown in the corn at the last cultivation, so as to be ready in the spring before the pastures are in condition to turn the sheep on them.

Vetches.—These are not as indifferent to climatic conditions as the crops previously mentioned, but where they can be grown they are invaluable for soiling sheep. They are very nutritious, and sheep thoroughly relish them. Mixed with one-third oats, with the object of supplying supports for the vines, they can hardly be surpassed as a soiling crop. In the drier sections, where the need of soiling crops is greater, the vetches can not be made to produce the amount of fodder that rape does.

Feeding ewes after weaning the lambs.—When the lambs have been taken away from the ewes, the latter should be put on scanty pasture or given the range of a field of grain stubble, to dry up the milk as soon as possible. The ewes, if they have done well by their lambs, will be in poor condition at this time, but it is not advisable to give them full feed.

FALL FEEDING OF BREEDING EWES.

It is a general impression among shepherds that the condition of the ewes at the time of breeding has a marked influence on the succeeding crop of lambs. If the ewes are in vigorous condition and improving in flesh, the prospects are thought to be favorable for the production of a large percentage of lambs. It is equally accepted that the condition of the ewes in the fall prior to going into winter quarters has an effect on the susceptibility of the flock to such diseases as are more or less prevalent during the winter season. It is certain that the ewes may be gotten into vigorous condition much more cheaply and easily in the early fall than at any time later, and it is equally true that a vigorous condition is the best preventive of disease.

Grain.—As the breeding season approaches (it usually begins in October), the ewes, being in thin condition, require some grain. The best grain for this time is clean sound oats, about 0.5 pound per head daily. If the ewes are brought into a uniformly good condition by grain feeding they will breed uniformly, which of itself is an appreciable advantage. During the past season, out of the flock of 55 breeding ewes at the Wisconsin Station, 52 lambed in the month of March, and this was due chiefly to the uniformity in the condition of the ewes, brought about by rape feeding.

Fall pasturage.—It is advisable to keep some fresh pasturage for late fall feeding. Exercise in the fall is conducive to thrift in winter and healthy lambs in the spring. In our northern

climate sheep are housed too much at best. The ewes may obtain more food than would be supposed from a field of fresh blue-grass pasture that has been in part retained for them.

It is becoming an opinion among shepherds that when ewes are fed on clover aftermath they are more difficult to get with lamb than if fed on other pasture or fed soiling crops. In addition there is danger that the sheep may bloat on it. The best plan is to save the second-crop clover for the lambs that have been weaned; and to prevent bloating pasture them for a part of the day on blue-grass pasture, and after they have satisfied their appetities to some extent, to change them to the clover.

FEEDING LAMBS INTENDED FOR BREEDING PURPOSES.

When the ewe has lambed, if the lamb after becoming dry is not able to obtain the ewe's milk of its own accord, it should be assisted in doing so. Some of the milk should be drawn from the udder to see that the milk escapes freely, and then the lamb held so that it may reach the teat. If it is too weak to stand, the ewe may be thrown, but it is perhaps better to draw some of the milk from the udder and feed it to the lamb from a spoon. By feeding a teaspoonful every hour for a half day or so, most weak lambs soon become strong enough to get to the teat themselves. It should be seen that there is no dirty wool around the udder or any filth about the teats to prevent the lamb from sucking. In the case of young ewes it is especially necessary that attention be paid to these matters. It is advisable to keep the ewe and her lamb in a pen by themselves for at least three days.

For feeding lambs to be used for breeding purposes preference should be given to bran, oats, and linseed meal. These are preferable to corn meal, which tends to fatten and does not produce growth to the same extent as the other foods. The bran is relished by the lambs, and they may eat large quantities of it without danger or detriment of any kind. Linseed meal is best fed in a mixture with the bran, as it is very rich and concentrated. Oats are seemingly liked by the lambs, but they will not eat them as freely as the other foods mentioned. If the oats are ground, the lambs leave a considerable quantity of the chaff untouched. The best results will likely be obtained by giving an equal mixture by weight of bran, oats, and linseed meal.

At first the lambs will take only small quantities of grain. By feeding them very little at a time and always taking away what they may leave they soon begin to eat eagerly and look forward to feeding time. To give young lambs all they have capacity for requires frequent feeding in small quantities. When the lambs are yet in the shed and not on pasture, our practice in feeding has been about as follows: In the morning about 6 o'clock they are fed a small quantity of grain, in the trough. After the other sheep are fed, if the lambs have eaten their grain more is put in the trough. At noon they receive another allowance. In the evening they are fed twice in the same manner as in the morning, and they are left at night with some grain in their troughs.

When the lambs are about 8 weeks old, they will eat about 0.17 pound of grain per head daily; when 10 weeks old, about 0.25 pound, and when 12 weeks old, about 0.5 pound.

Hand-feeding lambs.—In rearing lambs that have lost their mothers, or when the latter do not give enough milk to nourish the lambs properly, it is best to feed cow's milk from a bottle that has a small rubber nipple attached to it. A newly dropped lamb only requires 2 teaspoonfuls at a time given every hour. It has not been found necessary to sweeten the milk with sugar or dilute it with water, but it is strongly recommended to heat the milk and feed it at a temperature of 100 degrees F. The lambs seem to like it hot, and they certainly thrive better upon it. It is necessary to keep the nipple, the bottle, and the vessel in which the milk is heated thoroughly free from any disagreeable taste or odor, such as that of sour milk, else the lambs will refuse the milk. When the lambs are about 2 months old they are able to take in two feeds, 2 pints per head daily, in addition to such grain and grass as they may eat.

Feeding after weaning.—The time for weaning the lambs depends greatly up-

on the extent to which the lambs are obtaining milk from the ewes. When they are four months old they may usually be weaned with advantage. If they have been fed grain previous to weaning they will not be checked in their growth by it and they will be almost unconscious of the weaning; but if they have not received grain they will lose in weight and be checked in their growth.

It will be advisable to separate the ewe lambs from the ram and wether lambs. If allowed to run together the ram lambs will annoy the others and the gains will not be satisfactory. The wether and the ewe lambs may be kept together.

After weaning, the lambs should be gradually made to rely on oats as their grain ration. If on pasture of only ordinary quality, 0.5 pound of oats daily may be fed if needed, but if on good aftermath clover or blue-grass pasture less will be required.

When the lambs have just been weaned they should get the best pasture obtainable, and if possible the field should be some distance from the ewes. There is nothing better for lambs just weaned than second-growth clover that has grown up a few inches and has some of the freshness characteristic of new growth. There is not much danger of lambs of this age bloating on such food. Rape is an excellent food for the ram lambs, and if managed with judgment there is no danger in giving them free range. If neither of these can be secured for the lambs, they should at least have a clean piece of blue-grass pasture that has not been eaten down by other stock.

The best practice among shepherds giving close attention to the growth of their lambs is to sow rye in the fall for early food in the spring for the ewes and lambs, followed by vetch and oats and by vetch sown alone at intervals of two weeks. These last until the lambs are weaned and the clover aftermath is ready for them. Succeeding this comes the rape crop and fall turnips.

Feeding during winter.—During the first winter the ewe and ram lambs should receive special care. The aim should be to encourage growth as much as possible by good feeding without making them fat. Some grain, preferably oats, and wholesome fodders, such as clover hay, cut corn fodder, and others that they relish, should be fed. Until they become matured the ewe and ram lambs should be fed liberally, for any loss in growth that they may suffer through scrimped or neglected feeding can never be regained in later life.

FEEDING RAMS.

In feeding mature rams it is desirable to maintain them in a thrifty and vigorous condition without fattening. This implies wholesome food and exercise. If rams are made too heavy in flesh at any time, impotency or inability to serve ewes frequently results, and if they at once overfed and made too fat it is a very hard matter to reduce them without serious injury to their vitality. Exercise and not the reduction of their ration is the best remedy for reducing the flesh.

Winter feeding.—During the winter the object should be to maintain the weight if the ram is mature, and if a shearling or young ram to make continuous improvement. Oats are probably the best grain food, though the addition of some bran is advisable. A mature ram will need from 0.5 pound to 1 pound of grain daily to keep him in proper condition.

The fodder should be chosen so as to give as much variety as possible. They may include clover hay, pea straw, corn fodder, and others, fed at different intervals, or, perhaps better, one in the morning and another in the evening. Some succulent food should also be fed, such as turnips or silage. Experienced shepherds are very decided upon the danger from feeding mangel-wurzels. A great many rams have died from a formation of crystals in the bladder, and these have frequently been traced, it is believed, to the feeding of mangel-wurzels.

Summer feeding.—To secure the best results in the breeding season it is not advisable to let the rams run with the ewes before that time. They should be pastured as much as possible, for in this way they will keep healthier and stronger on their legs. Though the fleeces of the rams that run out may not appear to as good advantage as if housed, yet for results in breeding it is much the better plan to keep them on pasture as

much as possible. They should get some grain, the amount depending on their condition.

Fall feeding.—The feeding of the rams during the breeding season is very important. The grain should be mostly oats, with the addition of some bran and linseed meal. Such fodders as vetches and rape, fed in the shed, are recommended. The breeding season is a severe strain on the vitality of the ram, which has to be met by liberal feeding of grain and other foods in as great variety as possible. About 1 pound of grain daily will be required, with as much green food as the ram will eat. At this time it has been the writer's plan to keep the rams in pens by themselves and only allow them to go to the ewes each morning. Pasturage is replaced altogether by such green foods as rape and clover cut and brought to the pens.

FEEDING LAMBS FOR MARKET.

In feeding sheep for market the important consideration is the profit, and that depends on many circumstances. The feeding value of different foods, their cost, and the time occupied in fattening and marketing the sheep, are perhaps the most influential. It will be advisable to consider (1) the feeding of lambs that are to be sold to an early market some time during the interval from birth to weaning, (2) lambs intended for the fall market, and (3) those fed until they reach the period of their fullest development, which is usually when they are about 1 year old.

FATTENING LAMBS FOR EARLY MARKETS.

In preparing lambs for the early markets the best gain, to my knowledge, is that made by 3 lambs at the New York Cornell Station, which made a weekly gain per head of 5.36 pounds, extending over a period of nine weeks. Another lot of 3 made an average weekly gain of 4.47 pounds per head, extending over a period of twelve weeks. In neither case, however, is the composition of the ration or the amount of grain reported. The best gain in the writer's experience at the Wisconsin Station has been made by 4 lambs that were fed a mixture by weight of 4 parts of bran, 4 parts of corn meal, and 1 part of linseed meal. When the experiment started, the lambs were about 3 weeks old, and they were fed for ten weeks on grain ration, receiving in addition the milk of their mothers. The average weight of each lamb at the beginning of the experiment was 18.6 pounds, and at the end, 62.5 pounds, an average weekly gain per head of 4.48 pounds. They each ate 26.6 pounds of the grain mixture during the ten weeks, costing 18 cents per head.

The results that come next to these in profit were obtained from feeding a grain mixture consisting of 2 parts of ground wheat and 1 part of ground corn by weight. The lambs were about four and one-half weeks old when the experiment started, and averaged 26.1 pounds in weight. When the experiment ended, fourteen weeks later, they averaged 77 pounds in weight, having made an average weekly gain per head of 3.63 pounds. They each ate 40.5 pounds of the grain mixture in the fourteen weeks, costing 33.3 cents.

Another lot of 5 lambs, about six weeks old at the beginning, fed a mixture of equal parts of bran and linseed meal before weaning, made an average gain of 40.9 pounds in twelve weeks, or a weekly gain of 3.4 pounds per head. They ate 50 pounds of the grain mixture per head, which cost 37 cents.

In another trial with 14 lambs a mixture of bran, corn meal, and linseed meal gave an average weekly gain of 3.1 pounds, extending over a period of twelve weeks. During the first three weeks the mixture was 3 parts of bran and 1 part of linseed meal, and during the remaining nine weeks it was 2 parts of bran, 1 part of corn meal, and 1 part of linseed meal. The lambs each ate 42.7 pounds of the mixture during the twelve weeks, which cost 34 cents.

Considering these results, it is clear that corn meal is the leading food to feed young lambs for quick and profitable fattening. Bran probably ranks next, and with these linseed meal may usually be fed in small quantities to advantage.

FATTENING LAMBS FOR THE FALL MARKETS.

Under some conditions it may not be profitable to put the lambs on the market early or to carry them over winter.

but it may be better to sell them in November, before housing is required. The best weights that we have obtained at the Wisconsin Station with lambs fed until November have been made by the lambs previously mentioned as receiving bran, corn meal, and linseed meal before weaning. After weaning they were fed 2 parts of ground corn and 1 part of linseed meal by weight. On November 19 each lamb averaged 102.7 pounds in live weight, and in the nineteen weeks that elapsed since weaning they had made an average weekly gain of 2.66 pounds per head. They each ate 183 pounds of the grain mixture, in addition to pasturage, at a cost of $1.47 per head for the grain.

Linseed meal and cotton-seed meal.—In a comparison of these, in addition to corn meal for fattening lambs after weaning, a weekly gain of 3.3 pounds per head was obtained from the mixture of 2 parts of corn meal and 1 part of linseed meal, and 2.95 pounds per head from the mixture of 2 parts of corn meal and 1 part of cotton-seed meal, with pasturage. In the ten weeks' feeding the 5 lambs on the linseed-meal mixture had eaten 432.5 pounds of grain, while those receiving the cotton-seed meal ration ate 346.5 pounds of grain. In the last five weeks there were only 4 lambs in the latter lot. The cost of grain, exclusive of pasture, would be at the rate of $2.09 per 100 pounds for the linseed meal ration and $2.25 for the cotton-seed meal ration.

Oats with pasturage.—The feeding of oats to lambs being fattened on pasture after weaning has given us returns that are close to the foregoing ones. In one trial 5 lambs attained an average weight of 99.8 pounds in sixteen weeks after weaning, making an average weekly gain of 2.1 pounds per head. Before weaning they had been fed a grain mixture of bran, ground corn, and linseed meal, of which they ate 42.7 pounds, costing 34 cents per head, and after weaning they ate 6.9 pounds of the same mixture and 120.9 pounds of whole oats, costing $1.13 per head.

In another trial, 5 lambs being fattened on pasture after weaning were made to weigh an average of 97.6 pounds by November 8. In the twelve weeks before weaning they had gained an average of 3.4 pounds weekly by eating 50 pounds of equal parts of linseed meal and bran, costing 47 cents, and after weaning they received whole oats and pasture. During the fourteen weeks so fed they made an average weekly gain of 1.4 pounds, and they ate 52.1 pounds of oats per head, costing 56 cents.

More economical results were obtained by restricting the amount of oats to 0.5 pound per head daily while the lambs were on good pasturage. In the trial in which this amount was fed the 5 lambs gained during the twelve weeks 1.35 pounds per head weekly. They each ate 42 pounds of oats, costing 36 cents. These lambs were made to average 93.3 pounds by November 9. They were the same lambs previously described as being fed ground wheat and ground corn before weaning.

Cotton-seed cake and corn meal with pasturage.—In experiments at Woburn, England, conducted in behalf of the Royal Agricultural Society of England, trials extending over seven years have been made in fattening lambs with these foods in addition to pasturage on clover that had been seeded the previous year. Each year three or four lots of sheep in groups of 10 were annually fed off the acre of pasturage, with the following average results:

	Pounds.
680 pounds of undecorticated cotton-seed cake fed with 1 acre of pasturage gave an average increase of	376.5
728 pounds of corn meal fed with 1 acre pasturage gave an average increase of	377.1
No additional food with 1 acre of pasturage gave an average increase of	264.1

These results indicate that the feeding of these foods in addition to pasture would be profitable, and that the rate of gain, being 55.3 pounds per 100 pounds of cotton-seed cake and 51.7 p 100 pounds of corn meal, is slightly in favor of the former, while the cost of gain is favorable to the corn meal.

Fattening lambs on rape.—There are exceptional possibilities in well-grown rape for fattening lambs, if it is fed with proper judgment and care. It may be fed to best advantage in the early fall, and hence is of valuable as-

sistance in fattening lambs for the fall or early winter market. It supplies a vast amount of food that the lambs are very fond of, and as it withstands drought and early frost better than most succulent fodders it is a crop that may be relied upon with at least common certainty. The first trials reported with rape for fattening lambs were made in England about 1845. Ten wethers fed on rape alone from August 10 to September 21 made an average increase in the six weeks of 20 pounds, or 2 pounds per head weekly.

The most extensive trials in feeding lambs on rape have been carried on at the Ontario Experimental Farm. In 1890, 54 acres of rape pastured 17 heads of steers and 537 sheep, and 1 acre of the rape sustained 12 lambs for two months. It is estimated that the food provided by an acre of rape was worth $16.80. In another trial, rape alone was fed to 60 lambs, and they were kept on 2.18 acres for twenty-five days, during which time they increased in weight 390 pounds, or an average weekly increase per head of 1.82 pounds. Again, in an experiment on one-sixth of an acre, 6 lambs were kept for forty-two days, and from this it is concluded that 1 acre would have pastured 36 lambs two months and have made 762 pounds of mutton.

At the Michigan Station 15 acres of rape pastured 128 lambs for seven and a half weeks, with a total gain of 2,890 pounds. At this rate it is estimated that 1 acre would pasture 9 lambs seven weeks, and they would produce 202.5 pounds of increase. It is stated that the field would unquestionably have pastured 10 lambs for the period of ten weeks.

Rape and pasture.—At the Ontario Station an experiment was tried in feeding rape alone against rape and pasturage. Thirty lambs comprised the two lots, the one being put on an acre of rape and the other given a similar amount with pasture. In fifty-eight days both lots had eaten their respective acres, but the 15 on rape alone gained an average of 22.93 pounds per head, and those receiving rape and pasture 28 pounds per head, thus showing the advantage of having pasturage for the sheep to graze when being fed on rape.

Rape and oats.—At the same place 15 wethers were fed on an acre of rape, with 0.5 pound of oats in addition. Besides eating almost the whole of the crop from an acre in fifty-eight days, they also consumed 345 pounds of oats, and gained 23.67 pounds per head, or a weekly increase of 2.8 pounds per head.

Rape with corn and oats.—At the Wisconsin Station 16 wethers were fed on 0.7 of an acre of rape for twenty-five days, and also ate 153.5 pounds of oats and 97.5 pounds of whole corn. They gained a total of 149 pounds, or a weekly average of 2.6 pounds. Valuing the foods and the wethers at cost, and the selling price of the latter at 4 cents per pound, the rape would be worth $14.48 per acre.

Rape, wheat, oats, and linseed meal.—At the Wisconsin Station 21 wether lambs were fed on 0.5 acre of rape for ten weeks. They ate in addition a total of 1,439 pounds of the grain mixture, and made a total gain of 413.5 pounds, or a weekly gain slightly less than 2 pounds per head. Valuing the food at current prices, and estimating the lambs to be worth 3 cents per pound when they were put on the rape and 3.5 cents when taken away, the 0.5 acre would be worth $10.12, or an acre $20.24.

When these wethers had eaten the crop on 0.5 acre they were put on another piece that had been sown broadcast. One-tenth of an acre was eaten in two weeks, with 160 pounds of ground wheat, 160 pounds of linseed meal, and 160 pounds of ground oats, and the 21 wethers gained 142 pounds, or a weekly gain of 3.3 pounds per head.

Precautions necessary in feeding rape.—When sheep are being herded on rape there is danger of bloating or diarrhea from excessive eating. Pasturing the sheep for a few hours previous to turning them on the rape, or allowing them to have the range of a small piece of pasture at all times, will assist in preventing these troubles. The use of the trocar and cannula is the most efficient method of relieving bloat in urgent cases, while in mild attacks the giving of ammonia, a teaspoonful in three times as much water, will usually bring relief.

SHEARING WETHER LAMBS BEFORE FATTENING THEM.

When lambs are being fattened early in the fall or in preparing them for winter fattening, it is a profitable practice to shear them before the fattening begins. At the Ontario Experiment Station 10 lambs sheared in January made practically the same gain in weight as 10 others not shorn and similarly fed. At the Wisconsin Station no advantage has been found from shearing in December. Those shorn yielded total of 2 pounds less washed wool than the others and made a total gain of 2.7 pounds less than the wethers that were not shorn; and the cost of 100 pounds of gain was $4.70 for the shorn and $4.40 for the unshorn lots.

Shearing in November.—Shearing the wether lambs before fattening them in this month proves to be of slight advantage. The wethers that were shorn made 7 pounds more gain than those left unshorn, but the cost of gain was $4.44 per 100 pounds in comparison with $4.17 in the case of those that were not shorn. One advantage noted was the rapid fattening of the shorn wethers after shearing and during the first half, or first eight weeks, of the feeding period.

Shearing in October.—It was found decidedly beneficial to shear lambs in this month before fattening them. Five wethers were shorn October 14 and fed for fifteen weeks against another lot of 5 left unshorn. The shorn lot gained 225.5 pounds and the unshorn 210.5 pounds, or an average weekly gain per head of 3 pounds for the shorn and 2.8 pounds for the unshorn. The cost of 100 pounds of gain was $6.11 with the shorn lot and $6.67 with the unshorn. In another trial with 16 wethers, 8 were shorn October 6, and the same number left unshorn. In ten weeks' feeding the shorn lot gained 194.4 pounds, or 3.4 pounds per head weekly, while the unshorn lot gained 169 pounds, or 3 pounds per head weekly. In both of these trials in October and in the November trial it was observed that the removal of the fleece hastened the early maturity of fattening of the wethers up to the time the fleece had again grown over 1 inch in length, or until about eight weeks had passed.

FATTENING WETHER LAMBS TO MATURITY.

Preparation for fattening.—It is the common practice on most farms to withhold grain from the lambs for a time before and after weaning, in the belief that they will make quicker and more profitable gains while being fattened later. For four years we have fed lambs at the Wisconsin Station from birth until slaughtered, and have kept accurate account of their food and gain, so as to understand the influence of grain feeding at all times. The evidence is clear that the greatest and most profitable gain is made in the younger days of the lamb, and that the feeding of such food as bran, linseed meal, and oats before weaning and a small quantity of oats after weaning not only pays in direct profit if the lambs are sold at any of these times, but the fattening later is none the less profitable because of this management.

Feeding grain before weaning has produced an average of 61 cents per head more profit at weaning time than where no grain was fed. With lambs sold in the fall, feeding grain both before and after weaning produced an average of 34 cents per head more profit than where no grain was fed.

Feeding such foods as oats, bran, and linseed meal before and after weaning did not influence the gain during the fattening period, which usually extended over three months. The cost of gain, however, was 29 cents per 100 pounds cheaper in the instance of the lambs that had not been fed grain.

One of the most profitable features of grain feeding lambs previous to fattening was observed to be the earlier maturity of those that had had grain from birth. For instance, in one trial the lambs fed grain from birth attained an average weight of 113 pounds seven weeks earlier than those that had had no grain previous to fattening, and this weight was reached at a smaller cost in the instance of the lambs fed grain from the start.

System of feeding.—There is unlimited variation in general practice in regard to this point. It has been our custom to feed the grain first, then the succulent food, and last the dry fodder. In feeding fattening sheep of the age indi-

cated the aim should be to induce the wethers to eat as much as possible. At this time they should receive all the grain they will eat up eagerly. To secure the best results it is a good plan, where it is possible to do so, to feed the grain in two or even three feeds. This may be done easily when less than 100 are fed together, but with more than that it is not a commendable plan. By feeding only one-third of the full feed intended it is easy to gauge appetites of the wethers, which is a very important matter. The smallest degree of overfeeding is certain to react on the gain of the sheep, for in some instances it will probably cause scouring in others constipation, and it may even result in the loss of some of the lambs.

Essentials in management.—There are two essentials that contribute to cheap and rapid gains, and these are quietness and confinement. The least excitement brought on by the appearance of dogs, haste, or abuse on the part of the attendant is certain to be shown by the scales. For some time the Wisconsin Station used yards in connection with the fattening pens, but for the last two years they have been removed, and better results seem to have followed.

Quantity to feed.—Careful attention must be given to the amount of grain that is fed. This part of the ration costs most, gives the quickest returns, and is the most likely to produce some disorder in the digestion of the sheep. For the first two weeks it is much better to give them only one-half what they need than to feed them too much; especially is this true if over 50 sheep are being fed together. Starting the sheep safely and well on a ration brings the feeder's skill into play, particularly if the sheep have been unaccustomed to grain. There are some foods that are safer than others to feed at the beginning, and among these oats or bran have a general preference. Wheat is comparatively safe, while corn is probably the most dangerous to feed alone. One pound per head daily of either bran or oats is liberal feeding for sheep that are accustomed to grain, and a slightly smaller quantity will be sufficient for those that have not been accustomed to it. The quantity of grain may be gradually increased as the capacity of the sheep to consume it becomes greater. The careful and successful feeder trains his sheep to eat with as much carefulness as the trainer teaches a colt to trot. It is safe to assume that wethers at this age may be fed all the grain that they will eat, as it is usual for them to profitably utilize it in making gain, unless they are unhealthy or the management is defective. It is a hard matter to estimate the amount of grain to feed, owing to the variation in the consuming capacity of sheep. In starting it has been our custom to feed from 0.5 pound to 1 pound. A month later the wethers will probably be taking 1.5 to 2 pounds, and during the last month from 2 to 3 pounds per head has been the capacity of most of the sheep we have had in experiments.

Cost and value of the increase.—In comparing foods for fattening sheep it has been the custom to compare them on the basis of the cost of 100 pounds of gain, overlooking the increased value per pound which the sheep realizes in the market because of the increase that has been made during the feeding period. It is but a moderate advance to accept 3 cents per pound as the cost price of feeders and 4 cents per pound as the selling price when ready for market. Thus each pound that cost 3 cents when the feeding began becomes worth 4 cents at the close of the feeding, owing to the better condition of the sheep, which increases the percentage they will dress. This better condition is produced by the foods that are fed, so that in estimating the profits from any ration the ration should be credited with this increased value per pound of the sheep. Calculations of profit in succeeding experiments here mentioned have been made on this basis.

Fodders for fattening wether lambs.—There is no doubt as to the preference of the sheep in the choice of fodders, but there is no experimental data upon which to base conclusions as to their relative values. Clover hay seems to be the fodder they relish most, then pea straw, corn fodder, and timothy hay. The condition of the fodder will materially influence the gain, for if it is musty, burned, or dusty, or has been allowed to grow too coarse, they will neglect it Two or three pounds of any of the fodders mentioned will be about the quantity that wether lambs 9 or 10 months

old will eat daily through the fattening period.

Succulent foods for fattening lambs.—When being fattened wether lambs should have some succulent food in their ration for the reason that they will remain healthier and not be troubled with the common disorder called stretches, and they will usually make a better gain. It is very seldom that a group of sheep may be fattened on dry food without some of them dying or suffering with constipation.

At the New York Cornell Station two lots of 5 lambs each, about 8 mo old, were fed alike, except that one lot had corn silage and the other hay. In nineteen weeks the lot on silage gain a total of 132.5 pounds; the other lot gained 124 pounds in the same time. The silage ration was estimated to be the cheapest. Four pounds of silage were considered to be equivalent to 1 pound of hay.

The value of roots in a ration v shown by trials at the Michigan Station, in which corn and hay were compared with corn, roots, and hay. Te sheep on the former gained 328 pounds in fifteen weeks, as compared with 39 pounds on the corn, roots, and hay. The profit was about 3 cents per head more for the latter lot.

In other trials at the same sta corn and linseed meal were fed wit hay, against the same kind of grain and hay with roots. Ten lambs on the hay ration gained 357 pounds in fifteen weeks, while 10 on the hay and roots gained 392 pounds. In this case the profit was greater without than with the roots.

At the Wisconsin Station a ration of oats, corn, and linseed meal with hay was fed against a similar ration containing roots. The 4 lambs fed the former ration made a weekly average gain of 2.64 pounds per head and those fed the ration with roots made a weekly gain of 2.48 pounds per head. The profit was about 2 cents per head more from the ration without roots.

These results do not show a decided difference in favor of either ration, but in feeding large numbers the advantage more decidedly appears in favor of the succulent ration because of the decreased risk of deaths due to digestive derangements.

Roots and silage have been compared for fattening wether lambs without any marked difference in their value becoming apparent. If there is any, the rate of gain is in favor of the roots, and the cost of gain is favorable to the silage.

Corn.—This is assuredly the most fattening farm grain that may be fed to sheep. In relying on it alone, however, there is much difficulty in maintaining the appetities of the sheep and in preventing disorders and deaths. Corn, roots, and hay were fed in a ration at the Michigan Station against different rations, and the corn ration gave a weekly gain per head of 2.6 pounds, which was only equaled by a mixture of corn and oats.

Corn and hay were fed for fifteen weeks in trials conducted at the Michigan Station. The 10 wether lambs ate 1,579 pounds of corn and 1,095 pounds of hay and gained a total of 328 pounds, giving a profit of 59 cents per head. At the Wisconsin Station 5 wether lambs ate in eight weeks 427.75 pounds of corn and 288.5 pounds of hay and gained 104.5 pounds, giving a profit of 87 cents per head.

Cracked corn and hay were fed at the Minnesota Station to 10 wether lambs weighing 710 pounds, and in twelve weeks they ate 1,103 pounds of corn and 849 pounds of hay and gained 211 pounds, or an average weekly gain per head of 1.75 pounds. This ration returned a profit of 44 cents per head.

Oats.—In beginning to fatten wether lambs it is safe to feed oats. The lambs like them and they will begin to eat them at once. Fed alone, however, they do not produce as great a gain as corn. Hence, as the fattening proceeds, the quantity of oats should be gradually decreased.

At the Ontario Station 4 wether lambs were fed for fifteen weeks on oats, hay, and roots and gained 156 pounds, or a weekly increase of 2.6 pounds per head. At the Michigan Station 10 lambs fed for seventeen weeks on oats, hay, and roots gained 379 pounds, or a weekly average per head of 2.2 pounds. At average prices there was no profit in either case.

Oats and Swedish turnips were fed to 5 wether lambs weighing 548 pounds at Rothamsted, England, for ninety-seven days. The lambs gained 130.9 pounds,

or an average weekly increase of 1.9 pounds per head, giving a profit of only 3 cents per head.

Crushed oats were fed in feeding trials at Woburn, England, in connection with Swedish turnips and hay chaff, with the result that 8 wethers increased 380 pounds in one hundred and twelve days, or an average weekly gain of 2.9 pounds per head. This high rate of gain appears to have been due to the crushing of the oats. Crushed or "grittled" barley fed to similar sheep gave a weekly gain per head of 2.8 pounds, while whole oats and barley mixed in equal parts and fed in similar quantities to the foregoing gave an increase of 3 pounds per head per sheep, and wheat in the same experiment fed whole in similar quantities produced an increase of 3 pounds per head weekly. The large gains appear to be due to the fact that the sheep were good feeders.

Peas.—The best satisfaction will be obtained from feeding peas when they are split or crushed and fed with other foods. At the Ontario Station 4 wether lambs were fed in fifteen weeks 628 pounds of peas, 1,050 pounds of hay, and 460 pounds of roots, and gained 105 pounds, or an average weekly gain of 1.75 pounds per head. Charging the peas at 60 cents per bushel and the other foods at current prices, 45 cents per head was lost by feeding this ration.

Barley.—This grain has been experimented with for fattening sheep most extensively at the Rothamsted Station, in England. In one trial 5 wether lambs weighing 603 pounds, ate in eighteen weeks 630 pounds of barley and 1,879 pounds of clover chaff, and gained 139 pounds, or an average weekly increase of 1.54 pounds per head.

At the Minnesota Station 10 wethers weighing 733 pounds ate 1,268 pounds of barley and 630 pounds of hay in twelve weeks, and gained 199 pounds, or 1.65 pounds per head weekly. With barley at 45 cents per bushel and the other foods and the lambs at market prices there was a profit of 13 cents per head.

Ground barley has given slightly better returns. Four wether lambs weighing 519 pounds fed at the Rothamsted Station ate 280 pounds of ground barley and 3,867 pounds of mangel-wurzels in ten weeks and gained 81 pounds, or a weekly increase of 2 pounds per head. The average profit was 51 cents per head. In another trial at the same station ground barley was fed with meadow-hay chaff to 5 wethers weighing 589 pounds. In thirty-two weeks they ate 1,120 pounds of barley and 2,899 pounds of the chaff, and gained 164 pounds, or a weekly increase of 1 pound per head.

Crushd or grittled barley was fed to 8 wethers weighing 959.25 pounds. In one hundred and twelve days they ate 658 pounds of grittled barley, 17,472 pounds of Swedish turnips, and 224 pounds of hay chaff, and gained 365.75 pounds, or an average of 2.8 pounds per head weekly. Charging the barley at 45 cents per bushel, and the other foods at market prices, the increased value of the sheep shows that only market prices were obtained for the foods fed in this ration.

Wheat.—In an experiment at Woburn, England, with different rations, including linseed cake, linseed cake and undecorticated cotton-seed cake, crushed oats and barley meal, crushed oats and split beans, and, lastly, wheat, the wheat gave the largest gains. During the first period of the experiment it was fed in the form of meal, but was afterwards fed whole, with a very noticeable increase in the gains resulting. The 6 wethers fed wheat for one hundred and six days ate 558 pounds of wheat, and, as nearly as can be estimated, 12,720 pounds of roots and 277 pounds of hay chaff, and on this they gained 313 pounds, or an average of 3.4 pounds per head weekly. In another series of experiments at the same place with crushed oats, crushed barley, oats and barley mixed, wheat and oats mixed, and wheat alone, the best results were obtained from the whole wheat. The 8 wethers receiving the whole wheat in one hundred and twelve days ate 658 pounds of whole wheat, 17,920 pounds of Swedish turnips, and 224 pounds of hay chaff, and gained 389.25 pounds, or an average or 3 pounds per head weekly. In the first series the wether lambs fed the wheat ration yielded a profit of 18 cents per head, and in the second 12 cents, rating wheat at 53 cents per bushel.

Small wheat was fed at the Minnesota Station in an experiment to determine the value of the various grains for fattening wether lambs. Ten wether lambs weighing 737 pounds ate in twelve weeks 1,505 pounds of small

wheat and 742 pounds of hay, and gained 202 pounds, or an average weekly gain per head of 1.6 pounds. Valuing the small wheat at $10.56 per ton and the hay at $8, the profit returned by each lamb was 45 cents. In the same trial wheat screenings was fed to 10 wether lambs, weighing 736 pounds, and in twelve weeks they ate 1,776 pounds of the screenings and 609 pounds of hay, and gained 244 pounds, or an average weekly gain per head of 2 pounds. On the same valuation the profit from each wether lamb was 53 cents.

Sheep of all kinds and ages appear to be very fond of wheat bran, probably on account of its flavor and the fact that they digest it easily. Many of the large feeders in the west consider bran one of the safest and best foods to begin the feeding of large numbers, though they only rely on it alone for a few weeks.

Beans.—In the feeding experiments that have been made with beans as the only grain the results have been unsatisfactory. In a trial at Rothamsted, England, ground beans were fed with mangels in comparison with other grains, and a very unsatisfactory opinion was formed of their value, the sheep refusing to eat the beans and losing weight, so that the food had to be changed.

At the Ontario Station 4 wether lambs fed for fifteen weeks on beans, hay and roots gained 47.12 pounds, or an average of 0.95 pound per head weekly. This is a very small gain, and as a consequence the ration proved a very unprofitable one.

Linseed Cake.—This is a very healthy food for sheep, and they eat it eagerly, especially if it is not ground too fine. When crushed into pieces about the size of peas sheep eat it with relish. There is much difference in the different grades of linseed cake, and for this reason its feeding value varies greatly. In an experiment in England with linseed cake containing 6 or 7 per cent. of fat and other containing 15 or 16 per cent., the wethers ate very nearly the same amount of food on both kinds, while the gain with the linseed cake rich in fat was much the greater. It is estimated that this was worth $5 per ton more than the linseed cake low in fat.

In the trial conducted at Woburn with wheat, crushed oats and barley meal, crushed oats and split beans, linseed cake and undecorticated cotton cake, and linseed cake alone, the linseed cake was only second to the wheat in the rate of gain. The 8 wether lambs fed the linseed cake ration weighed 916.5 pounds at the beginning of the experiment, and in one hundred and six days they ate 588 pounds of linseed cake, and, as nearly as may be estimated, 16,960 pounds Swedish turnips, and the average weekly gain per head was 3.3 pounds, as compared with 3.4 pounds on wheat, 2.6 pounds on crushed oats and barley meal, 2.7 pounds on the mixture of crushed oats and split beans, and 2.7 pounds on the mixture of linseed cake and undecorticated cotton cake. While the linseed-cake ration gave a very high rate of increase, yet it was not a profitable ration, for only market prices were obtained for the foods fed.

In another series of experiments at the same place, in which linseed cake alone and mixtures of it with barley and malt were fed to sheep, the highest rate of increase was obtained from the linseed cake alone.

Results from feeding unmixed grains.—From the results presented in the outline of what had been accomplished in the feeding of single grain foods, it is evident that there are but a few of them that give profitable returns when fed alone. Some give a high rate of gain, but the cost absorbs the profit, and others yield satisfactory gains so long as the sheep will eat them and continue in good health. At the average current prices the indications of the experiments are that corn is much the most profitable single grain to feed, next to which rank such as wheat, cotton-seed meal, or linseed, while most of the others enumerated barely pay returns equal to their market prices, and some, such as beans and bran, fail to do this.

Grain mixtures.—There is abundant evidence indicating that the merit of a grain mixture as a part of the ration lies in the fact that the sheep like it better than the unmixed grains, eat more of it, and as a result gain more. The fact that they eat more seems to

be the chief element in making the profit less than in the feeding of some of the foods unmixed.

Peas and Corn.—In an experiment in feeding whole corn, corn and peas, corn and oats, and corn, peas and oats to wether lambs, in addition to hay, the corn gave the poorest results of all, so far as the rate of gain is concerned, the average weekly gain per lamb being 2.6 pounds on corn, 2.7 pounds on oats and corn, 3.15 pounds on corn and peas, ad 3.01 pounds on corn, peas and oats. The cost of 100 pounds of gain was, corn, $3.99; corn and oats, $4.46; corn and peas, $4.20, and corn, peas and oats, $4.46.

Oats and Corn.—This mixture is probably more frequently used than any other in the west. In trials at the Michigan Station the 10 lambs receiving corn and oats, with roots and hay, were only equalled in weekly gains by those fed corn alone. This mixture surpassed bran alone, corn and bran mixed, oats and bran, and another of corn, oats and bran, in weekly gain and in cost of gain.

At the Wisconsin Station it has been our custom, in fattening lambs that have been fed grain continuously from birth, to feed oats at first during the fattening, then add corn, and finally, if the lambs appeared to need it, to add some linseed meal. In one of the trials corn and oats were fed alone to 15 lambs throughout the fattening (twelve weeks) with hay in addition. They ate 1,523.5 pounds of corn, 1,073 pounds of oats, and 1,320 pounds of hay, and gained 529.5 pounds, or an average of 2.9 pounds per head weekly. The profit on the lambs fed this ration at the Michigan Station would amount to 54 cents per head, while that from those fed in our trials would be 67 cents. These figures indicate that, both in direct profit and rate of gain, the oats and corn mixture gives results superior to most other mixtures, while observation of the conduct of the wethers when being fed this ration justifies the assertion that it is an exceptionally wholesome food for sheep.

Peas, oats and corn.—Five wethers fed a grain mixture of peas, oats and corn with hay made an average weekly gain of 3 pounds per head. The profit was 76 cents per head, which was slightly below that of a lot receiving corn and peas, and also less than that of a lot on whole corn.

Bran, oats and corn.—This mixture was tried at the Michigan Station, in comparison with bran and oats and bran and corn. In the seventeen weeks the average weekly gain was 2.10 pounds per head on bran and corn, 2.11 pounds on bran and oats, and 2.3 pounds on the mixture of bran, oats and corn. The profit on the bran and corn ration was 21 cents per head, on the oats and bran ration 10 cents, and on the bran, oats and corn ration 22 cents per head. It will be seen from these trials that the best returns in profit resulted from feeding the corn and bran mixture and the corn, oats and bran ration, for both of these surpassed the oats and bran.

Wheat and Corn.—This grain mixture was fed to one lot of wether lambs at the Michigan Station, in comparison with other grain mixtures, and very satisfactory results were obtained from it. Ten wether lambs weighing 800 pounds ate in fifteen weeks 743 pounds of corn, 743 pounds of wheat, and 1,183 pounds of hay, and gained 293 pounds, or an average of 1.97 pounds per head weekly. They gave a profit of 38 cents per head if we charge the wheat at 53 cents per bushel, corn at 40 cents, and hay at $8 per ton. This is a better return than the oats and bran, bran and corn, and oats, bran and corn mixture fed in the same trial.

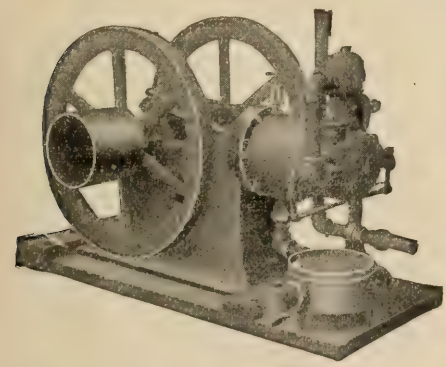
Corn and linseed meal.—In the above trials at the Michigan Station corn and linseed meal gave high results. Ten wether lambs weighing 829 pounds ate in fifteen weeks 347 pounds of linseed meal, 1,388 pounds of corn, and 1,152 pounds of hay, and gained 357 pounds, or an average of 2.38 pounds per head weekly. A profit of 41 cents per head resulted from feeding this ration. Cracked corn, and linseed meal were fed in a ration at the Minnesota Station to 10 wether lambs weighing 722 pounds. In twelve weeks they ate 142 pounds of linseed meal, 1,284.3 pounds of cracked corn, and 634 pounds of hay, and gained 289 pounds, or an average of 2.4 pounds per head weekly. The profit from feeding this grain mixture with hay was 55 cents per head.

Barley and linseed meal.—This mixture was fed in the same experiment as the preceding at the Minnesota Station. Ten wether lambs weighing 757 pounds ate in twelve weeks 159 pounds of linseed meal, 1,431.9 pounds of barley, and 603 pounds of hay, and gained 274 pounds, or an average of 2.2 pounds per head weekly. There was a profit of 13 cents per head, which is not so great as that resulting from the ration containing wheat and linseed meal.

Oats, barley and wheat.—In the sheep-feeding trials at Woburn, Eng., oats and barley mixed equally by weight returned a weekly increase of 3 pounds per head, the oats alone 2.9 pounds, barley alone 2.8 pounds, and the oats and wheat 2.6 pounds per head weekly. Wheat alone did the best of all the grains fed, it giving a weekly increase of 3.06 pounds per head.

Corn, oats and linseed meal.—The results that have been submitted from the feeding of different rations will go far toward justifying the practice we have followed in fattening wether lambs. They would be started on oats and fed lightly for two or three weeks, then corn would be introduced, and for seven or eight weeks the grain portion of the ration would be corn and oats. During the last two or three weeks linseed meal would be added to the ration, and on this mixture the wethers would be finished. Though this mixture has not been fed in a trial against other grains, in three trials with this ration the average weekly gain per head has been 2.88 pounds, 2.9 pounds, and 2.98 pounds respectively, and the profit per head has been 93 cents, 27 cents and 26 cents.

The result of these trials declare corn to be the most profitable grain for fattening sheep. But practice teaches that other grains must be fed with it to maintain the appetites of the sheep and keep them otherwise healthy. It will likely be safest and best under most conditions to start the fattening with oats or bran, then introduce as much corn as possible and finish the fattening with a mixture containing one part oats, one part oil meal and three parts corn by weight. The data given in the trials described will indicate what the advantage may be in using other foods under special circumstances.



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THE DOMINION OF CANADA.

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The following is a list of the Governors-General and Governors of the several provinces before Confederation, together with the years of office:

FRENCH.

1534. Jacques Cartier, Captain-General.
1540. Jean Francois de la Roque, Sieur de Roberval.
1598. Marquis de la Roche.
1600. Captaine de Chauvin (acting).
1603. Commander de Chastes.
1607 Pierre du Guast de Monts, Lieut.-General.
1608. Comte. de Soissons, 1st Viceroy.
1612. Samuel de Champlain, Lieut.-General.
1633. Samuel de Champlain, 1st Governor-General.
1635. Marc Antoine de Bras de fer de Chateaufort (Administrator).
1636. Chevalier de Montmagny.
1648. Chevalier d'Aillesboust de Coulonge.
1651. Jean de Lauzon.
1656. Charles de Lauzon-Charmy (Administrator).
1657. D'Ailleboust de Coulonge.
1658. Viscomte de Voyer d'Argenson.
1661. Baron Dubois d'Avaugour.
1663. Chevalier de Saffray de Mesy.
1665. Marquis de Tracy. (a)
1665. Chevalier de Courcelles.
1672. Comte. de Frontenac.
1682 Sieur de la Barre.
1685. Marquis de Denonville.
1689. Comte. de Frontenac.
1699. Chevalier de Callieres.
1703. Marquis de Vaudreuil.
1714-16 Comte. de Ramesay (acting).
1716. Marquis de Vaudreuill.
1725. Baron (1st) de Longueuil (acting).
1726. Marquis de Beauharnois.
1747. Comte. de la Galissoniere. (b)
1749. Marquis de la Jonquiere.
1752. Baron (2nd) de Longueuil.
1752. Marquis Duquesne-de-Menneville.
1755. Marquis de Vaudreuil-Cavagnal.

(a) Marquis de Tracy was the King's Lieutenant-General in America, and during the period he was in Canada, 30th June, 1665, to 28th August, 1667, he was virtually Governor of Canada.

(b) Acting during captivity of La Jonquiere.

ENGLISH.

1760. Gen. Jeffrey Amherst.
1764. Gen. James Murray.
1768. Gen. Sir Guy Carleton (Lord Dorchester)
1778. Gen. Frederick Haldimand.
1786. Lord Dorchester.
1797. Major-General Prescott.
1807. Sir James Craig.
1811. Sir George Prevost.
1815. Sir Gordon Drummond (acting).
1816. Sir John Coape Sherbrooke.
1818. Duke of Richmond.
1819 Sir Peregrine Maitland (acting).
1820. Earl of Dalhousie.
1828. Sir James Kempt.
1830. Lord Aylmer.
1835. Lord Gosford.
1838. Earl of Durham.
1839. Sir John Colborne (Lord Seaton).
1839. Hon. C. P. Thompson (Lord Sydenham).
1842. Sir Charles Bagot.
1843. Sir Charles Metcalfe.
1845. Earl Cathcart.
1847. Earl of Elgin.
1855. Sir Edmund Walker Head.
1861. Lord Monck.

SINCE CONFEDERATION.

The following is a list of the Governors-General of Canada since Confederation, with the date of their respective appointments:

The Right Hon. Viscount Monck, G. C.M.G.; date of appointment, June 1, 1867; date of assumption of office, July 1, 1867. The Right Hon Lord Lisgar, G.C.M.G. (Sir John Young); date of appointment, December 29, 1868; date of assumption of office, February 2, 1869. The Right Hon. the Earl of Dufferin, K.P., K.C.B., G.C.M.G.; date of appointment, May 22, 1872; date of assumption of office, June 25, 1872. The Right Hon. the Marquis of Lorne, K. T., G.C.M.G., P.C., etc; date of appointment, October 5, 1878; date of assumption of office, November 25, 1878. The Most Honorable the Marquis of Lansdowne, G.C.M.G., etc.; date of appointment, August 18, 1883; date of assumption of office, October 23, 1883. The Right Hon. Lord Stanley of Preston,* G.C.B.; date of appointment, May 1, 1888; date of assumption of office, June 11, 1888. The Right Hon. the Earl of Aberdeen, K.T., K.C.M.G.; date of appointment, May 22, 1893; date of assumption of office, September 18, 1893.

*Succeeded to the Earldom of Derby on the death of his brother, April 21, 1893.

GOVERNOR-GENERAL AND STAFF.

Governor-General His Excellency the Right Hon. Sir Gilbert John Elliot, Earl of Minto, G.C.M.G., etc., £10,000 and residence.

Staff—Secretary of the Governor-General, Major F. S. Maude, C.M.G., D.S.O., Coldstream Guards, Government House, Ottawa.

Aides-de-Camp—Captain A. C. Bell, Scots Guards; Capt. I. H. C. Graham, Coldstream Guards; Comptroller of the Household, Arthur Guise, Esq.

Honorary Aides-de-Camp—Col. W. D. Otter, C.B., Lieut.-Col. De la O. T. Irwin, C.M.G., Hon. Col. the Hon. J. M. Gibson, 13th Regt.; Lieut.-Col. G. T. A. Evanturel, 9th Regt.; Lieut.-Col. J. Peters, C. W. Drury, C.B.; Lieut.-Col. A. P. Sherwood, C.M.G.; Lieut.-Col. H. R. Smith, Col. F. L. Lessard, C.B., Col. T. D. B. Evans, C.B., Major W. Forester, R. C.D.; Col. L. Buchan, C.M.G.

THE CABINET.

(Ministry formed 13th July, 1896, with changes to date.)

Prime Minister—The Right Hon. Sir Wilfrid Laurier, G.C.M.G., P. C., President of the King's Privy Council..... $8,000

Minister of Trade and Commerce, Right Hon. Sir Richard J. Cartwright, G.C.M.G..... 7,000

Secretary of State, Hon. Richard William Scott..... 7,000

Minister of Militia and Defence, Hon. Sir Frederick William Borden, K.C.M.G..... 7,000

Postmaster-General and Minister of Labor, Hon. Sir William Mulock, K.C.M.G..... 7,000

Minister of Agriculture, Hon. Sydney Arthur Fisher..... 7,000

Minister of Finance, Hon. William Stevens Fielding..... 7,000

Minister of Interior and Superintendent-General of Indian Affairs, Hon. Clifford Sifton..... 7,000

Minister of Customs, Hon. William Patterson..... 7,000

Minister of Public Works, Hon. James Sutherland..... 7,000

Minister of Justice, Hon. Charles Fitzpatrick..... 7,000

Honorable William Templeman (without portfolio)..... .....

Minister of Marine and Fisheries, Hon. J. Raymond Fournier Prefontaine..... 7,000

Minister of Railways and Canals, Hon. Robert Emmerson, K.C..... 7,000

Minister of Inland Revenue, Hon. Louis Philippe Brodeur, K.C., L.L. B..... 7,000

Hon. Charles S. Hyman (without portfolio)..... .....

Member of Cabinet, in addition to regular salary, receive $1,500 sessional allowance.

Not in the Cabinet.

Solicitor-General of Canada, Hon. Rudolphe Lemieux..... 5,000

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Clerks.

Assistant Clerk of the Privy Council, Rodolphe Boudreau.

Clerk of the Crown in Chancery, H. G. Lamothe.

First-class Clerks—F. K. Bennets, J. G. Foley, and S. Lelievre.

High Commissioner for Canada in London, Lord Strathcona and Mount Royal, C.C.M.G.

Secretary Office of the High Commissioner for Canada in London, William Linney Griffith.

First-class Clerk, Christopher Joseph Taylor.

Deputy Clerk of the Crown in Chancery, J. G. Foley.

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" F. L. Beique	Montreal
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" J. Bolduc	St. Victor de Tring, Que.
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" T. Coffey	London, Ont.
" G. A. Cox	Toronto
" R. Curry	Windsor, N.S.
" R. Dandurand	Montreal
" L. O. David	Montreal
" J. Dever	St. John, N.B.
" J. Dobson	Lndsay, Ont.
" J. Domville	Rothesay, N.B.
" G. A. Drummond	Montreal
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" D. Ferguson	Charlottetown, P.E.I.
" J. B. R. Fiset	Rimouski, Que.
" L. J. Forget	Montreal
" F. T. Frost	Smith's Falls, Ont.
" T. Fulford	Brockville, Ont.
" W. Gibson	Beamsville, Ont.
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" W. Kerr	Cobourg, Ont.
" J. K. Kerr	Toronto
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" A. C. P. Landry	Notre Dame de Quebec, Que.
" J. H. Legris	Louiseville, Que.
" J. A. Lougheed	Calgary, N.W.T.
" J. Lovitt	Yarmouth, N.S.
" A. A. Macdonald	Charlottetown, P.E.I
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Deputy Clerk and Second Clerk Assistant	1,800
Chaplain—vacant	500
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Second English Clerk—Alex. Soutter	1,800
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Avery, Melzar, Addington, Sharbot Lake, Ont.

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Beland, Henri Severin, Beauce, St. Joseph de Beauce, Que.

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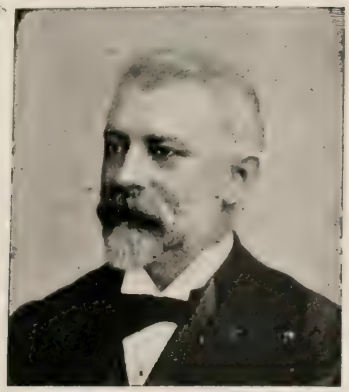

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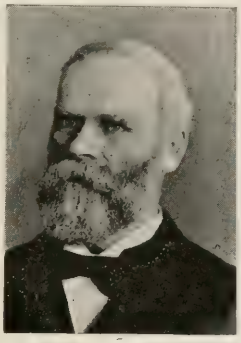

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Ontario, A. G. Duncan, Marksville 1,200
Ontario, J. M. Hurley, Belleville 1,200
Quebec, A. H. Belliveau, Dept. of Marine and Fisheries, Ottawa
Yukon Territory, T. A. Stewart, Dawson City 1,000
Prince Edward Island, J. A. Matheson, Campbellton 1,200
Quebec, W. Wakeham, Gaspe, Quebec... 1,700
Inspector of Gulf Division, Dr. N. Lavoie, L'Islet..... 1,000
British Columbia, C. B. Sword, New Westminster 1,500
N. W. Territories, E. W. Miller, Fort Qu'Appelle 900
N. W. T., H. S. Young, Edmonton..... 900
Manitoba, W. S. Young, Selkirk.... 1,200

DEPARTMENT OF THE INTERIOR.

Minister of the Interior, Hon. Clifford Sifton.. .. ..$7,000
Deputy Minister of the Interior, James A. Smart.. 3,200
Law Clerk, T. G. Rothwell.. .. 2,400
Private Secretary to Minister, John L. Payne 2,050
Secretary, P. G. Keyes.. 2,400
Assistant Secretary, L. C. Pereira 1,800
Registrar of Correspondence, K. J. Henry..... 2,150
Clerk in Charge of Timber and Mines, G. U. Ryley..... 2,350
Clerk in Charge of Ordnance and Admiralty Lands, J. N. Ferguson..... 1,350

Patent Branch.

Chief Clerk, W. M. Goodeve.. .. 2,400

Accountant's Branch.

Accountant, Chief Clerk, C. H. Beddoe..... 2,150

Surveys Branch.

Surveyor-General, E. Deville..... 2,500
Chief Astronomer, W. F. King..... 2,500
Assistant Astronomer, Otto J. Klotz..... 2,300

DEPARTMENT OF THE INTERIOR. OUTSIDE SERVICE.

Commissioner of Dominion Lands, J. G. Turriff, Ottawa.. .....$3,000
Chief Inspr. of Surveys, Wm. Pearce.... 3,000
Superintendent of Mines, Eugene Haanel, Ph.D..... ... 3,000

Inspector Dominion Lands Agencies and A.D.L., Winnipeg, E. F. Stephenson.. 2,500
Chief Clerk, T. R. Burpe, Ottawa, 2,300
Inspector of Forestry, E. Stewart, Ottawa.. 2,500

Dominion Lands Agents.

Alameda, R. C. Kisbey.....$1,200
Yorkton, J. E. Peaker (Actg.)..... 900
Brandon, L. J. Clement..... 1,400
Minnedosa, John Flesher.... .. 1,200
Regina, D. S. McCannel.... 1,400
Prince Albert, J. W. Hannon...1,200
Edmonton, A. G. Harrison..... 1,400
Calgary, J. R. Sutherland 1,400
Battleford, R. F. Chisholm 500
Red Deer, W. H. Cottingham .. 1,200
Lethbridge, A. J. Fraser 1,200
Dauphin, F. K. Herchmer 1,200
Dominion Lands Agent, New Westminster, B.C., John McKenzie.. 1,400
Crown Timber Agent, New Westminster, B.C., James Leamy.. 1,500
Dominion Lands Agent, Kamloops, B.C., James Bannerman... 1,400
Secretary to the Lieut-Governor of the District of Keewatin, Norman Hill..... 500

Registrars of the N.W. Territories.

Registrar District of Assiniboia, F. F. Forbes..... 2,000
West Saskatchewan District, R. F. Chisholm.. 1,300
East Saskatchewan District, S. G. Brewster..... 1,600
District of South Alberta, W. R. Winter..... 2,000
District of North Alberta, George Roy 1,600

Immigration.

Superintendent of Immigration, W. D. Scott, Ottawa 2,700
Commissioner of Immigration, J. Obed Smith... 3,000

Immigration Agents.

Montreal, J. Hoolahan.. 1,200
Quebec, P. Doyle.. 1,400
Port Arthur, J. M. McGovern.. 1,000
Halifax, N.S., F. W. Annand..... 1,100
St. John, N.B., J. V. Lantalum..... 1,100

YUKON TERRITORY.

Commissioner, F. T. Congdon..... 6,000
Gold Commissioner, E. C. Senkler 5,000
F. X. Gosselin, Asst. Gold Commissioner.. 4,000
Legal Adviser, H. W. Newlands.. 5,000
Registrar, J. E. Girouard..... 4,000
Comptroller, J. T. Lithgow..... 3,000
Crown Timber and Dominion Land Agent, H. M. Martin.... 2,400
Inspector, W. W. Cory..... 2,400

GEOLOGICAL SURVEY DEPARTMENT.

Minister, Hon. Clifford Sifton, Minister of the Interior.....
Acting Deputy Head and Director, Robert Bell, D. Sc., M.D., LL.D., F.R.S.
Asst. Director, Paleontologist and Zoologist, J. F. Whiteaves, LL.D., F.R.C.S., F.G.S..... 2,450
Asst. Director, Chemist and Mineralogist, G. C. Hoffmann, LL.D., F.I.C., F.R.S.C..... 2,450
Asst. Director, Botanist and Naturalist, John Macoun, F.L.S., F.R.S.C..... 2,300
Mining Engineer and Geologist, E. D. Ingall, M.E., A.R.S.M..... 1,950
Chief Clerk and Accountant, John Marshall..... 1,850
Chief Draughtsman and Geographer, C. O. Senecal, C.E..... 1,500
Geologists, R. W. Ells, M.A., LL. D., Hugh Fletcher, B.A., R. G. McConnell, B.A., each $2,200; Robert Chalmers, $1,750; Wm. McInnes, B.A.Sc., 1,750; E. R. Fairbault, B.A.Sc., $1,750; Alfred E. Barlow, D.Sc., M.A., $1,700; D. B. Dowling, B.A.Sc., $1,500; R. W. Brock, M.A., B.A. Sc., $1,250; Theo. Denis, B.A.Sc., $1,050; Jos. Keele, B.A.Sc., $1,100; W. W. Leach, B.A.Sc., $1,100; W. J. Wilson, Ph.B., $1,100.
Artist and Asst. Paleontologist, Asst. Paleontologist, Henry M. L. M. Lambe, F.G.S..... 1,750
Ami, M.A., D.Sc., F.G.S..... 1,750
Asst. Botanist, J. M. Macoun.... 1,650
Asst. Chemists, F. G. Walt, M. A., $1,600; R. A. A. Johnston.. 1,400
Museum Curator, C. W. Willimott..... 1,400
Museum Asst., R. L. Broadbent. 1,400
Librarian, John Thorburn, LL.D.. 800

DEPARTMENT OF INDIAN AFFAIRS.

Inside Service.

Superintendent General, Hon. Clifford Sifton.
Deputy Superintendent General, Francis Pedley $3,200
Chief Clerk and Secretary, John D. McLean..... 2,400
Chief Clerk and Asst. Secy., Samuel Stewart..... 2,000
Chief Clerk, Law Clerk, Reginald Rimmer..... 2,100
Chief Clerk and Accountant, Duncan C. Scott..... 2,200
Private Secretary to the Superintendent General, Jas. B. Harkin..... ... .., ... 1,750
First Class Clerks: John McGirr, $1,800; Robert G. Dalton, $1,650; Wm. A. Orr, $1,650; S. Bray, D.L.S., $1,600; A. E. Kemp. 1,400
Second Class Clerks: Henry C. Ross, $1,400; James J. Campbell, $1,400; Edwin Rochester, $1,400; Hiram McKay, $1,350; Martin Benson, $1,350; Henry J. Brook, $1,250; John D. Sutherland, $1,250; John W. Shore, $1,250; John H. Antliff, M.A.Sc., D.T.S., $1,250; Geo. M. Mattheson, $1,100; R. B. E. Moffat..... 1,100
Officers of Outside Service at Headquarters:—
Inspector of Indian Agencies and Reserves. J. A. Macrae.. .....$1,800
Inspector of Timber, Geo. Lang Chitty..... 1,200
Frederick H. Paget..... 1,700

Outside Service.

Ontario.

Indian Superintendents, Edwin D. Cameron, Brantford, $1,400; W. B. Maclean, Parry Sound, $900; and commission..... .....
Clerks, D. S. Hill, Brantford, $900; A. McG. Ironside, Manitowaning, $720..... ....
Medical Officers, F. H. Mitchell, M.D., Delaware, $260; L. Secord, M.D., Brantford, $2,850; R. W. Williams, M.D., Allenford, $300.
Guardians of Islands, O. V. Goulette, Gananoque, $150; J. A. Gibson, Mallorytown, $25.

English, A., Sarnia..... 500

Indian Land Agents, Joshua Adams, Sarnia; W. J. C. Ferguson, Wiarton.....

Indian Agents.

Hagan, Samuel, Thessalon..... 500
Hodder, J. F. M., Port Arthur... 800
McDonald, A. R., Duart..... 500
McDougall, J. B., Wallaceburg... 500
McFarlane, Wm., Keene..... 325
McGibbon, Chas., Penetanguishene 500
McIver, J., McIver..... 500
McPhee, D. J., Atherley..... 400
Mullin, Martin, Killaloe, Ont. 60
Nichols, William L., Sault Ste. Marie..... 825
Scoffield, J., Chippewa Hill..... 500
Sims, C. L. D., Manitowaning.. 1,000
Sutherland, S., Delaware..... 600
Thackeray, J., Roseneath.. 325
Thorburn, Robert, Gore Bay..... 600
Williams, A. W., Port Perry.... 100
Yates, John, Vachell..... 350

Quebec—Indian Agents.

Bastien, A. O., Jeune Lorette 425
Beaulieu, E. Cacouna, commission and..... 150
Blain, Jean, Montreal..... 600
Burwash, A., N. Temiscamingue, commission and 200
Comire, A. O., M.D., St. Francois du Lac..... 300
Desilets, C. O. H., M.D., Becancour 100
Gagne, Rev. J., Maria..... 100
Gagnon, A., Bersimis..... 400
Long, Geo., St. Regis, commission and..... 50
Marcoux, Alphonse, Pointe Bleue... 400
McCaffrey, W. J., Maniwaki..... 600
Pitrie, Jeremie, Pointe a la Garde. 200
Perillard, Joseph H., Oka, Que..... 200
Scott, W. D. B., Mingan..... 400
Medical Officer, Ed. A. Mulligan, M.D., Maniwaki..... 200
Missionary, Rev. G. Giroux, Lorette..... $225.96

Nova Scotia—Indian Agents.

Beckwith, C. E., Steam Mills.... $50
Cameron, Rev. A., Christmas Island, N.S..... 75
Fraser, Rev. John, St. Peters.... 100
Harlow, Chas., Caledonia Corner 100
Irwin, R. G., Shelburne..... 50
Lacy, John, Annapolis.. 50
MacAdam, Rev. D., Sydney, C.B.... 75
Macdonald, A. J., Baddeck 100
McDonald, J. R. Heatherton.. 100
McLeod, Rev. J. D., New Glasgow. 100
MacPherson, Rev. D., Glendale.. 100
McManus, Rev. C. E., Sheet Harbor 50
Purdy, Jas. H., Bear River..... 50
Rand, F. A., M.D., Parrsboro'.... 50
Smith, T. B., Truro..... 50
Wallace, A., Shubenacadie..... 50
Whalen, Wm. H., Yarmouth..... 50

New Brunswick.

Indian Agents, Wm. D. Carter, Richibucto, $400; James Farrell, Fredericton, $500.....
Medical Officer, John S. Benson, M.D., Chatham.. 100

Prince Edward Island.

Indian Superintendent, John O. Arsenault, Higgins Road..... $300

British Columbia.

Indian Superintendent, A. W. Vowell, Victoria..... 3,200
Clerks, William B. MacLaughlin, Victoria, $1,500; Henry G. Dalby, Victoria 720
Stevens, W. A..... 1,000
Surveyor, Ashdown H. Green, Victoria 1,800

Indian Agents.

Bell, Ewen, Clinton.. ..... $1,200
De Beck, G. W., Alert Bay 1,200
Galbraith, R. L. T., Fort Steele... 1,200
Irwin, A., Savona..... ..... $1,200
Loring, R. E., Hazelton..... 1,200
McDonald, R. C., New Westminster 1,200
Morrow, G. W., Metlakatla..... 1,800
Neill, Alan W., Alberni..... 1,200
Robertson, W. R., Quamichan... 1,200

Manitoba, Keewatin and Northwest Territories.

Indian Commissioner, Hon. D. Laird, Winnipeg.... ..... $3,200
Asst. Indian Commissioner and Chief Inspector, James A. J. McKenna, Winnipeg 2,400
Secretary, J. B. Lash, Winnipeg 1,700
Clerks, G. A. Betournay, M.A., Winnipeg, $1,200; J. E. Jean, Winnipeg, $1,000.....

Inspectors.

Asst. Surveyor, J. L. Reid, Sr., D. L.S., Winnipeg..... 1,400
Calgary Inspectorate, Alex. McGibbon, Calgary 2,200
Qu'Appelle Inspectorate, L. J. A. Leveque, Regina 1,800
Battleford Inspectorate, W. J. Chisholm, Prince Albert..... 2,000
Lake Manitoba Inspectorate, S. R. Marlatt, Portage la Prairie, Man..... 2,000
Lake Winnipeg Inspectorate, S. J.

Jackson, Stonewall, Man..... 2,000
Treaty No. 8 Inspectorate, H. A. Conroy.... 1,800

Indian Agents.

Aspdin, Thos. W., Sintaluta, Assa..$ 900
Begg, Magnus, Broadview, Assa.. 1,100
Carruthers, H. A., Cote, Assa..... 1,000
Courtney, J., The Pas., Sask..... 1,000
Day, J. P. G., Battleford, Sask... 1,000
Gibbons, Jas.. Edmonton, Alta.... 1,000
Graham, W. M., Qu'Appelle, Assa.. 1,400
Grant, W. S., Hollbroke, Alta.... 1,000
Jones, W. E., Duck Lake, Sask.... 1,000
MacArthur, Jas., Mistawasis, Sask. 1,000
Mann, G. G., Saddle Lake, Alta.. 1,000
Markle, J. A., Gleichen, Alta..... 1,400
Martineau, H., Kutawa, Assa.... 1,200
McKenzie, R. S., Rat Portage, Ont.. 1,000
McNeil. A. J.. Calgary, Alta..... 1,000
Murison, William, Carlyle, Assa.... 900
Semmens, Rev. J., West Selkirk, Man..... ....$1,000
Sibbald, H. E., Morley, Alta..... 900
Sibbald, Wm., Onion Lake, Sask.. 900
Swinford, S., Portage la Prairie, Man..... 1,200
Wheatley, G. H., Birtle, Man..... 1,200
Wilson, James, Macleod, Alta. (Blood Indians) 1,200
Wilson, R. N., Macleod, Alta. (Piegan Indians) 1,000
Wright, J. P., Fort Frances, Ont... 1,200
Medical Officers, O. C. Edwards, M. D., Macleod, Alta., $1,800; S. T. Macadam, M.D., Battleford, Sask..... 900
J. D. Lafferty, M.D.. Gleichen, Alta 1,800
J. R. Steep, M.D., Winnipeg, Man. 800
Clerk, J. W. Jowett, Broadview, Assa..... 660

AUDITOR-GENERAL'S OFFICE.

Auditor-General, John Lorn McDougall, C.M.G. $4,000
Chief Clerk, Exchequer Branch, E. D. Sutherland..... 2,350
Chief Clerk, Revenue Branch, J. Gorman..... 2,300
Chief Clerk, Expenditure Branch, F. Hayter..... 2,300
First Class Clerks—A. B. Hudson, J. W. Reid, Wm. Kearns, each $1,700; J. S. Stevenson.. 1,500
Also seven Second Class Clerks and thirteen Junior Second Class Clerks.

DEPARTMENT OF AGRICULTURE.

Minister of Agriculture and Commissioner of Patent, Hon. Sidney Fisher..... ... . $7,000
Deputy Minister of Agriculture and Deputy Commissioner of Patents, Geo. F. O'Halloran 3,200
Secretary, A. L. Jarvis..... 2,312.50
Private Secretary, T. K. Doherty..... .... 2,050.00
Acting Accountant, F. C. Chittick..... .... 1,550.00

Archives Branch.

Copyrights and Trade Marks Branch.
Registrar, J. B. Jackson..... 2,400

Patents Branch.

Chief Clerk, W. J. Lynch..... 2,200

Statistics Branch.

Statistican, George Johnson..... 2,400
Assistant Statistican, E. H. St. Denis..... 1,800

Quarantine and Public Health.

Director General Public Health, F. Montizambert, M.D..... 4,000

Health of Animals.

Chief Veterinary Inspector, J. G. Rutherford, V.S... 2,750

Census.

Special Census Commissioner, A Blue 4,000

DEPARTMENT OF RAILWAYS AND CANALS.

Minister of Railways and Canals, Hon. Robert Emmerson, K.C.... $7,000
Deputy Minister and Chief Engineer, C. Schreiber, C.M.G. 6,000
Secretary, Chief Clerk, L. K.Jones 2,400
Accountant, Chief Clerk, S. Leonard Shannon 2,400
Chief Clerk Records, M. W. Maynard 2,100
Law Clerk, Chief Clerk, Gerard G. Ruel 2,050
Chief Clerk, Correspondence, F. A. Dixon.. 1,800
First Class Clerks: Neil Stewart, $1,800; L. H. Filteau, $1,800; J. E. W. Currier, $1,800; J. W. Pugsley, $1,650; C. D. Chubbuck, $1,550; R Devlin, $1,500; H. Le B. Ross, $1,550; J. L. Payne, $1,500; C. W. Ross, $1,500.
Second Class Clerks: A. U. Almon, $1,400; L. N. Fortier, $1,300; L. D. Dion, $1,200; W. C. Little, $1,200; A. W. Cameron, $1,100.

DEPARTMENT OF PUBLIC PRINTING AND STATIONERY.

King's Printer and Comptroller of Stationery, S. E. Dawson ..$3,200

Accountant's Branch.

Accountant, W. Gliddon..... ... 2,400

Printing Branch.

Superintendent of Printing, W. McMahon..... 2,250

Stationery Branch.

Superintendent of Stationery, Frank S. Gouldthrite.... 1,800

DEPARTMENT PUBLIC WORKS.

Minister of Public Works, Hon. James Sutherland.
Deputy Minister, A. Gobeil.
Secretary, Fred. Gelinas..... ..
Asst. Secretary, R. C. Desrochers..
Acting Chief Engineer, E. D. Lafleur
Chief Architect, D. Ewart.....
Chief Accountant, A. G. Kingston.
Private Secretary, James B. Hunter.
Chief Clerk, R. Steckel $2,400

DEPARTMENT OF JUSTICE.

Minister of Justice, Hon. Chas, Fitzpatrick, K.C. $7,000 00
Solicitor-General, Rodolphe Lemieux 5,000 00
Deputy Minister, E. L. Newcombe, K.C. 4,000 00
Chief Clerks, A. Power, K.C., I. S. O. and G. L. B. Fraser, K.C. 2,800
Minister's Private Secretaries, J. D. Clarke, $1,950.00, and J. Mullin $1,800.00.
Deputy's Secretary, John Leslie . 1,800
Accountant, J. E. Narraway 1,450 00
H. B. Verret and J. Mullin, Solicitor-General's Private Secretaries.

Penitentiary Branch.

Inspectors of Penitentiaries, Douglas Stewart, and G. W. Dawson 2,600
Accountant, E. Heeker 1,900
Clerk, H. B. S. Lane 1,500 00

Dominion Police.

Commissioner, A. P. Sherwood.. 2,400

The Supreme Court of Canada.

Registrar of Supreme Court and Editor of Supreme Court Reports, E. R. Cameron, K.C. 3,200
Reporter, C. H. Masters, K.C. 2,100 00
Asst. Reporter, L. W. Coutlee 1,650 00

The Exchequer Court of Canada.

Registrar, L. A. Audette 2,700
Reporter, Charles Morse 1,750 00

POST OFFICE DEPARTMENT.

Postmaster-General, Hon. William Mulock, K.C. $7,000
Deputy Postmaster-General, R. M. Coulter 3,200

Secretary's Branch.

Chief Clerk and Secretary, Wm. Smith, B.A..... 1,850
Private Secretary to Postmaster-General, E. H. Laschinger.... 600
First Class Clerks, A. W. Throop, $1,800 ; L. A. Maingy, Draughtsman, $1,650; E. H. Laschinger, $1,550; C. Pope, $1,600; B. M. Northrop, $1,500; F. G. Moon, $1,400.
Second Class Clerks, J. H. Brown. E. Bunel. C. P. V. Beroard, F. C. Anderson. E. H. Matthewman, each, $1,150 to..... 1,400

Accountant's Branch.

Chief Clerk and Accountant, W. J. Johnstone..... 2,100
First Class Clerks,
John Graham.... 1,650
W. J. Glover 1,400
Second Class Clerks, E. H. Benjamin, L. Blanchet, D. F. McCarthy, W. Greaves, D. A. Barrett, T. McGrail, M. K. Dunlevie. H. S. Shaw, J. M. Conroy, J. G. Fortier, J. C. Martin, G. L. Plunkett, H. S. Campbell, $1,150 to..... 1,400

Money Order Branch.

Chief Clerk and Superintendent, W. Rowan..... 1,800
First Class Clerk, S. S. Thorne 1,800
Second Class Clerks, J. F. Wall, $1,400; F. E. S. Grout, $1,250; T. Wilson, $1,150; W. R. Hanley.. 1,100

Savings Bank Branch.

Chief Clerk and Superintendent, W. H. Harrington.. 2,600
First Class Clerk, W. H. Eagleson.... 1,450
Second Class Clerks, J. H. Fairweather, W. H. Kreps, W. H. McCuaig, E. E. Taylor, J. H. Bollard, H. N. P. Chesley, each, $1,100 to 1,400

Postal Stores Branch.

Chief Clerk and Controller, Sidney Smith $2,400
First Class Clerk, W. D. O'Brien.. 1,500
Second Class Clerk, R. Greenfield..... 1,300
J. Briggs..... 1,150

Dead Letter Branch.

Chief Clerk and Superintendent, John Walsh..... 2,350
First Class Clerks, G. R. White,

G. J. Binks, each, $1,600 to..... 1,750
Second Class Clerks, P. J. Brennan, H. Knauf, J. Prendergast, $1,150 to 1,400

Mail Service Branch.

Chief Clerk and Superintendent, G. C. Anderson..... 1,850
First Class Clerks, W. E. Bennett, F. H. Smith, $1,700 to..... 1,800
Second Class Clerks, H. W. Griffin, E. L. Learoyd, $1,150 to..... 1,400

Postage Stamp Branch.

Chief Clerk and Superintendent, E. P. Stanton..... 2,150
First Class Clerk, E. Daubney..... 1,600
Second Class Clerks, H. O. Gray, E. L. Taylor, each, $1,250 to..... 1,400

Railway Mail Service Branch.

Chief Clerk and Controller, B. M. Armstrong 2,500
First Class Clerk, F. K. Rochester..... 1,450
Second Class Clerk, T. A. Godfrey..... 1,250

Post Office Inspectors.

Nova Scotia., Halifax.....
Prince Edward Island (P. O. Inspector), Charlottetown.....
New Brunswick, N. R. Colter .. 2,200
Quebec, A. Bolduc, Quebec..... 2,200
Montreal, J. W. Bain.. 2,200
Ottawa, F. Hawken, Ottawa 2,400
Kingston, H. Merrick 2,200
Toronto, James Henderson 2,200
London, Henry C. Hopkirk 2,400
Manitoba and Northwest Territories, W. W. McLeod, Winnipeg 2,600
British Columbia, E. H. Fletcher, Victoria, $2,200; Vancouver, W. H. Dorman 2,000

CUSTOMS DEPARTMENT.

Minister of Customs, William Paterson $7,000
Commissioner, John McDougald..... 3,600
Asst. Commissioner, John Bain..... 2,800
Accountant, R. R. Farrow 2,150
Assistant Accountant, T. J. Code.... 1,600
Chief Clerk of Statistics, F. G. Benet 1,950
Chief Clerk of Seizures, F. Morin.....1,800
Chief Clerk of Correspondence, T. A. D. Bliss 1,500
Inspectors of Ports, D. D. O'Meara, J. J. Bremner, J. S. MacLaren, George H. Young, J. S. Clute, Alex. McKay, T. Clappison, A. Shaw, H. A. Lemieux, H. W. Allan, S. McDonnell, each 2,000
Chief Inspector, S. W. McMichael.. 2,500
Analyst, F. W. Babington 1,800

Board of Commission.

Chairman, John McDougald, Commissioner.
John Bain, Asst. Commissioner.
Dominion Appraiser, W. S. Wood... 1,800
R. W. Breadner 1,800
S. W. McMichael, Chief Inspector.

Collectors of Customs—From $4,000 to $300 each.

Abercorn, J. Dunn.
Amherst, B. W. Baker.
Amherstburg, M. Barrett.
Annapolis, E. McCormack.
Antigonish, A. Boyd.
Arichat, A. F. Boudrot.
Baddeck, J. A. Fraser.
Barrington, T. W. Robertson.
Bathurst, P. J. Veniot.
Berlin, F. Colquhoun.
Belleville, W. Webster.
Bowmanville, J. Beith.
Brandon, Man., H. C. Graham.
Brantford, Thos. Foster.
Bridgeburg, James Lawson.
Brockville, W. H. Jones.
Calgary, Alex. Allan.
Campbellton, A. McKenzie.
Canso, P. C. Cullen.
Charlottetown, W. B. Robertson.
Chatham, N.B., D. Ferguson.
Chatham, Ont., D. R. Farquharson.
Coaticook, John B. Daly.
Cobourg, G. F. Jones.
Collingwood, George Watson.
Cookshire, A. Ross.
Cornwall, John Bergin.
Dalhousie, Geo. Haddow.
Dawson, E. S. Busby.
Deseronto, A. S. Valleau.
Digby, J. M. Viets.
Fort William, F. C. Perry.
Fredericton, A. F. Street.
Galt, Thomas Peck.
Gananoque, W. H. Britton.
Gaspe, A. J. Kavanagh.
Goderich, Asher Farrow.
Grand Forks, B.C., R. R. Gilpin.
Guelph, J. Hallett.
Halifax, W. D. Harrington.
Hamilton, F. E. Kilvert.
Hemmingford, F. S. Proper.
Ingersoll, J. F. Williams.
Kaslo, J. F. McIntosh.
Kentville, F. C. Rand.
Kingston, Clarke Hamilton.
Lethbridge, John Kenny.
Lindsay, W. Lownsborough.
Liverpool, J. H. Dunlap.
Lockeport, James R. Ruggles.
London, Geo. Burns.
Lunenburg, A. B. Coldwell.
Mansonville, W. Lynch.
Middleton, L. P. Schaffner.
Midland, Ont., W. J. Parkhill.
Moncton, I. W. Binney.
Montreal, R. S. White.
Morrisburg, A. J. Laflamme.
Nanaimo, B. H. Smith.
Napanee, J. B. Allison.
Nelson, G. Johnston.
Newcastle, N.B., W. A. Park.

New Westminster, Angus Munn.
Niagara Falls, A. Boyle.
North Sydney, Jos. McPherson.
Oshawa, George F. Blamey.
Ottawa, J. W. Russell.
Owen Sound, N. P. Horton.
Paspebiac, P. C. Beauchesne.
Paris, Thomas Hall.
Parrsborough, E. Gillespie.
Perce, W. Flynn.
Peterboro', Robert Hall.
Picton, Walter T. Ross.
Pictou, N.S., Robt. P. Fraser.
Port Arthur, A. M. Wiley.
Port Hawkesbury, Jno. Hennessey.
Port Hood, E. D. Tremaine.
Port Hope, E. J. W. Burton.
Prescott, E. Jessup.
Quebec, J. B. Forsyth.
Regina, S. B. Jameson.
Rimouski, J. Gauvreau.
Rossland, B. R. McDonald.
Sackville, J. J. Anderson.
Sarnia, G. N. Matheson.
Sault Ste. Marie, H. Plummer.
Shelburne, W. W. Atwood.
Sherbrooke, M. T. Stenson.
Simcoe, Nat Porter.
Sorel, J. Mathieu.
St. Armand, E. A. Bourret.
St. Catharines, J. E. Cuffe.
St. Hyacinthe, G. H. Henshaw.
St. John, N.B., W. A. Lockhart.
St. John's, Que., H. W. Wood.
St. Stephen, Henry Graham.
St. Thomas, Daniel Ferguson.
Stanstead, C. H. McClintock.
Stratford, J. G. Hess.
Summerside, C. W. Strong.
Sydney, R. McDonald.
Three Rivers, P. B. Vanasse.
Toronto, John Small.
Trenton, F. J. McGuire.
Truro, G. P. Nelson.
Vancouver, J. M. Bowell.
Victoria, A. R. Milne, C.M.G.
Valleyfield, S. A. Brodeur.
Wallaceburg, J. H. Fraser.
Weymouth, N. B. Jones.
White Horse, H. B. Shadwell.
Whitby, J. R. Philp.
Windsor, N.S., Wm. O'Brien.
Windsor, Ont., W. McGregor.
Winnipeg, Thomas Scott.
Woodstock, F. H. J. Dibblee.
Woodstock, Ont., W. H. VanIngen.
Yarmouth, W. H. Moody.

NORTHWEST MOUNTED POLICE.

List of officers of the Northwest Mounted Police:

Northwest Territories.

Commissioner, A. B. Perry, Regina; Assistant Commissioner, J. H. McIlree, Regina; Superintendents, R. B. Deane, Maple Creek; A. H. Griesbach, Battleford; C. Constantine, Fort Saskatchewan; G. E. Sanders, D.S.O., Calgary; P. C. H. Primrose, Macleod; W. S. Morris, Prince Albert; J. O. Wilson, Regina; J. V. Begin, Lethbridge; A. C. Macdonell, D.S.O., Regina; ; J. D. Moodie, Hudson Bay. Inspectors, J. A. McGibbon, Macleod; C. Starnes, Maple Creek; Creek; H. S. Casey, Lethbridge; H. J. A. Davidson, Pincher Creek; D. A. Strickland, Regina; R. Belcher, C.M.G., Edmonton; A. N. Jarvis, C.M.G., Regina; W. H. Irwin, Macleod; E. G. Brown, Regina; W. M. de R. Williams, Regina; F. L. Cartwright, D.S.O., Prince Albert; F. J. A. Demers, Fort Saskatchewan; C. H. West, Lesser Slave Lake; S. Crosthwait, T. McGinnis, W. M. Walke, Regina G. S. Worsley, Calgary; J. H. Heffernan, Regina; W. C. Wickham, Macleod; R. S. Knight, Regina; W. Parker, Saskatoon; A. W. Duffus, Lethbridge; Assistant Surgeon, G. P. Bell, Regina; Veterinary Surgeon, J. Burnett, Macleod.

Yukon Territory.

Assistant Commissioner, Z. T. Wood, Dawson; Superintendent, A. E. Snyder, White Horse; A. E. R. Cuthbert, Dawson; Inspectors, W. H. Routledge, D. M. Howard, Dawson; F. J. Horrigan, White Horse; A. E. C. McDonell, Dalton Trail; E. A. Pelletier, White Horse; John Taylor Dawson; A. LaRocque, White Horse; R. Y. Douglas, Dawson; J. Richards, White Horse; Assistant Surgeon, L. A. Pare, White Horse; S. M. Fraser, Dalton Trail; W. E. Thompson, Dawson; G. Madore, Fort Selkirk; Vet. Surgeon, T. A. Wroughton, Dawson.

PROVINCE OF ONTARIO.

Entered Confederation 1st July, 1867.
Population, 1901- 2,182,947
Seat of Government—Toronto.
Lieutenant-Governor, Hon. Wm. Mortimer Clark, $10,000; Official Secretary, Commander F. C. Law, R.N., $1,200.

EXECUTIVE COUNCIL.

Premier and Treasurer, Hon. G. W. Ross, LL.D. $7,000
Attorney-General, Hon. J. M. Gibson 4,000
Minister of Education, Hon. Richard Harcourt, M.A., K.C. 4,000
Commissioner of Public Works, Hon. F. R. Latchford, K.C. 4,000
Provincial Secretary, Hon. J. R. Stratton 4,000
Crown Lands, Hon. E. J. Davis .. 4,000
Minister of Agriculture and Registrar, Hon. John Dryden 4,000

Officers of the Legislative Assembly.
Clerk of the House and Clerk of the Crown in Chancery, Charles Clarke 1,800

Assistant Clerk, Arthur H. Sydere 1,500
Librarian, Avern Pardoe 1,500
Clerk and Postmaster, J. M. Delamere 1,000
Accountant, Lud. K. Cameron 400
Law Clerk, A. M. Dymond 900
Sergeant-at-Arms, F. J. Glackmeyer 600
House Keeper and Chief Messenger, P. O'Brien 900

PROVINCIAL TREASURER'S DEPARTMENT.

Treasurer, Hon. G. W. Ross; also Premier .....
Assistant Treasurer, W. N. Anderson 2,500

Premier's Office.

Premier, Hon. Geo. W. Ross..... 7,000

Provincial Auditor's Branch.

Provincial Auditor, C. H. Sproule.$2,400
Asst. do., W. W. Wood..... 1,550
Bookkeeper, A. J. Rattray 1,500

King's Printer.

King's Printer, L. K. Cameron..$1,800
Asst. do., S. P. Grant.

ATTORNEY-GENERAL'S OFFICE.

Attorney-General, Hon. J. M. Gibson $4,000
Deputy Attorney-General, J. R. Cartwright, K.C. 3,000
Legal Secretary, A. M. Dymond .. 800
Assistant Clerk Executive Council, J. L. Capreol 1,650
Municipal Auditor, J B. Laing .. 2,000
Inspector of Registry Offices, D. Guthrie, K.C., Guelph 1,750
Inspector of Insurance, J. Howard Hunter, M.A... 2,800

DEPARTMENT OF PUBLIC WORKS.

Commissioner, Hon. F. R. Latchford $4,000
Asst. Commissioner, A. W. Campbell.. 2,400
Secretary, William Edwards.. 1,000
Consulting Engineer and Architect, Kivas Tully..... 1,500
Engineer, R. P. Fairbairn... 1,800
Architect, F. R. Heakes..... 1,900
Accountant and Law Clerk, J. P. Edwards..... 1,350
Assistant Engineer and Architect, H. E. Moore..... 1,200
Assistant Clerk and Paymaster, M. C. O'Donnell.. 1,200

Colonization Roads Branch.

Superintendent, Henry Smith..... 1,900
Accountant, M. P. Doherty..... 1,000

Highways Branch.

Clerk, W. A. McLean..... 900

Fisheries Branch.

Deputy Commissioner, S. T. Bastedo..... 2,200
Chief Clerk, J. S. Webster..... 1,400

Game Protection.

Chief Warden, E. Tinsley..... 1,300

Labor Bureau.

Robert Glockling..... 1,500

PROVINCIAL SECRETARY'S DEPARTMENT.

Provincial Secretary, Hon. J. R. Stratton $4,000
Assistant Secretary, Thomas Mulvey, K.C. 2,500
Chief Clerk, J. B. McLachlan 1,400
First-class Clerk, J. D. Waide..... 1,350

REGISTRAR-GENERAL'S DEPARTMENT.

Registrar-General, Hon. J. R. Stratton $4,000
Deputy Registrar-General, Charles A. Hodgetts, M.D. 2,500
Inspector, Col. R. B. Hamilton..... 1,300
Chief Clerk, G. W. Wheler 1,100
Messenger, W. Latimer 500

PROVINCIAL BOARD OF HEALTH.

Chairman, E. E. Kitchen, M.D., St George 400
Secretary, Chas. A. Hodgetts, M.D. .....
Provincial Analyst, John A. Amyot, M.D. 1,600
Clerk, G. B. Lindsay 1,000
Asst. Clerk, D. Paton 650
Messenger, G. Jones 550

Neglected Children's Department.

Superintendent, J. J. Kelso $1,600
W. O'Connor, Inspector.
Children's Visitor, Mrs. L. J. Harvie 700

Office of Prisons and Public Charities.

Inspector of Asylums, R. Christie $2,600
Inspector of Prison and Public Charities, T. F. Chamberlain, M.D., $2,500; James Noxon.... 2,400

Public Institutions.

Asylums for Insane, Toronto, Superintendent, Daniel Clarke, M. D. $2,000
G. A. MacCallum 2,000
Bursar, Wm. Tracy 1,400
London Asylum, Superintendent, R. M. Bucke, M.D. 2,000
Bursar, C. A. Sippi 1,400
Asylum for Insane, Kingston, Superintendent, C. K. Clarke, M.D. 2,000
Bursar, W. R. Dick 1,200
Asylum for Insane, Hamilton, Superintendent, James Russell, M. D. 2,000
Bursar, Bidwell Way 1,400
Asylum for Insane, Mimico, Superintendent, N. H. Beemer, M. D. 1,800
Bursar, James Corcoran 1,400
Asylum for Insane, Brockville, Superintendent, Thos. J. Moher, M.D. 2,000
Superintendent, J. B. Murphy, M.D. 1,800
Bursar, W. P. Dailey 1,200
Asylum for Idiots, Orillia, Superintendent, A. H. Beaton, M.D... 1,800

Bursar, T. J. Muir 1,300
Central Prison, Toronto, Warden, J. T. Gilmour 2,000
Bursar, Alexander Jaffray 1,300
Reformatory for Boys, Penetanguishene, Superintendent, Thos. McCrossen 1,800
Bursar, William P. Band 950
Institute for Deaf and Dumb, Belleville, Superintendent, R. Matheson 1,800
Institution for the Blind, Brantford, Superintendent, F. F. Gardiner 1,575
Bursar, W. N. Hossie 1,100
Andrew Mercer Reformatory for Females, Toronto, Superintendent, Mrs. E. O'Sullivan 1,000
Physician, J. S. King, M.D. 800
Bursar, R. W. Laird 1,100

License and Administration of Justice Accounts Branch

Chief Officer, Eudo Saunders $2,000
Accountant, J. F. Mowat 1,550

DEPARTMENT OF CROWN LANDS.

Commissioner of Crown Lands, Hon. E. J. Davis $4,000
Assistant Commissioner, Aubrey White..... 3,250
Law Clerk, G. Kennedy..... 2,200

Sales and Free Grants Branch.

Chief Clerk, J. J. Murphy..... 1,900

Surveys and Patents.

Director of Surveys, G. B. Kirkpatrick, O.L.S..... 2,200
Chief Clerk of Patents, C. S. Jones. 1,600

Woods and Forests Branch.

Chief Clerk, J. A. G. Crozier.... 1,800
Accountant 1,450

Forestry and Colonization.

Director of Forestry and Colonization, Thomas Southworth. 1,900

Accounts Branch.

Accountant, D. G. Ross $1,800

Bureau of Mines.

Director of Mines, Thos. Gibson.... 2,500

Crown Timber Agents.

Ottawa, E. J. Darby.
Parry Sound, F. Halliday.
Port Arthur, H. Munro.
Sault Ste. Marie, P. C. Campbell.
Quebec, B. Nicholson.
Rat Portage, W. Margach.
Webbwood, E. Garrow.
Pembroke, John C. Kennedy.

Crown Lands Agents.

Apsley, T. G. Eastland.
Bracebridge, William Kirk.
Brudenell, John Whelan
Dryden, A. E. Ames.
Emo, Wm. Stephenson.
Emsdale, E. Handy.
Fort Frances, Geo. Sleeman.
New Liskeard, J. Armstrong.
Haliburton, C. R. Stewart.
L'Amable, J. R. Tait.
Magnetawan, A. G. Best.
Minden, W. Hartle.
Powassan, J. S. Scarlett.
Plevna, A. W. Wood.
Parry Sound, James Ellis.
Pembroke, James Stewart.
Parry Sound, W. P. Christie.
Port Arthur, W. H. Hesson.
Rat Portage, M. Seigmiller.
Sudbury, Chas. Henderson.
Sault Ste. Marie, Jos. Maughan.
Stratton Station, Wm. Campbell.
Sturgeon Falls, J. D. Cockburn.
Temiscaming, E. B. Lloyd.
Thessalon, T. G. Wigg.
Walford, R. J. Whalen.

EDUCATION DEPARTMENT.

(St. James' Square, Toronto.)

Minister of Education, Hon. Richard Harcourt $4,000
Deputy Minister of Education, John Miller, B.A. 2,500
Librarian and Historiographer, J. G. Hodgins, LL.D. 2,000
Minister's Private Secretary, Henry R. Alley.
Superintendent Mechanical Institute and Arts Schools, S. P. May, M.D..... 1,700
Registrar of Educational Council, Wm. Pakenham, B.A. 1,750

DEPARTMENT OF AGRICULTURE.

Minister, Hon. John Dryden; also Registrar $4,000
Deputy Minister and Secretary Bureau Industries, C. C. James 2,500
W. O. Gallagher, Chief Clerk..... 1,500
Assistant Secretary of Bureau, W. F. McMaster 1,700
Superintendent of Farmers' Institutes, G. A. Putnam 1,500

Ontario Factories Inspectors.

Jas. T. Burke, Parliament Buildings, Toronto, $1,000; Thos. Kelly, Parliament Buildings, Toronto 1,000
T. R. Brown, Parliament Buildings, Toronto 1,000
O. A. Rocque, Orleans, Ont. 1,000
Miss Margaret Carlyle, Parliament Buildings, Toronto..... 600

AGRICULTURAL COLLEGE, GUELPH.

President, G. C. Creelman, B.S.A...$2,000

Prof. of Dairying, H. H. Dean, B. S.A.	1,600
Director of Field Experiments, C. A. Zavitz, B.S.A.	1,800
Veterinary Surgeon, J. Hugo Reed, V.S. (part time)	1,000
Prof. of Agriculture, G. S. Day, B. S.A.	2,000
Prof. of Horticulture, H. L. Hutt, B.S.A.	1,800
Prof. of Physics and Lecturer in English, J. B. Reynolds, B.A.	1,800
Prof. of Bacteriology, F. C. Harrison, B.S.A.	1,500
Prof. of Biology and Geology, W. Lochhead, B.A., M.S.	1,600
Prof. of Chemistry, R. Harcourt, B.S.A.	1,500
Manager Poultry Dept., W. R. Graham, B.S.A.	1,100
Lecturer in Apiculture, H. R. Rowsome	200
Lecturer in Chemistry, W. P. Gamble, B.S.A.	1,100
Lecturer in Agriculture, M. Cumming, B.A., B.S.A.	1,100
Dean of Residence and Instructor in English and Mathematics, J. A. McLean, B.A.	700
Assistant in Library and Instructor in French and German	300
Demonstrator in Biology, J. W. Hotson, B.A.	1,000
Demonstrator in Chemistry, E. G. de Coriolis, B.S.A.	700
Demonstrator in Biology, T. D. Jarvis, B.S.A.	700
Demonstrator in Physics, W. H. Day, B.A.	700
Fellow in Horticulture, H. S. Peart, B.S.A.	450
Instructor in Drill and Gymnastics, Captain W. Clark	300
Bursar, S. Springer	1,100

MEMBERS LEGISLATIVE ASSEMBLY

G—Represents Gov. Supporters. O—Opposition

Addington	James Reid, Opp.
Algoma	W. R. Smythe, Opp.
Brant North	D. Burt, Govt.
Brant South	T. H. Preston, Govt.
Brockville	G. P. Graham, Govt.
Bruce Centre	Hugh Clark, Opp.
Bruce North	C. M. Bowman, Govt.
Bruce South	R. Truax, Govt.
Cardwell	E. A. Little, Opp.
Carleton	G. N. Kidd, Opp.
Dufferin	Dr. Barr, Opp.
Dundas	J. P. Whitney, Opp.
Durham East	J. J. Preston, Opp.
Durham West	W. Rickard, Govt.
Elgin East	C. A. Brower, Opp.
Elgin West	F. Macdiarmid, Opp.
Essex North	Dr. J. O. Reaume, Opp.
Essex South	J. A. Auld, Govt.
Fort William and Lake of the Woods	D. C. Cameron, Govt.
Frontenac	J. S. Gallagher, Opp.
Glengarry	W. D. McLeod, Opp.
Grenville	R. L. Joynt, Opp.
Grey Centre	I. B. Lucas, Opp.
Grey North	A. G. McKay, Govt.
Grey South	Dr. Jamieson, Opp.
Haldimand	J. W. Holmes, Govt.
Halton	John R. Barber, Govt.
Hamilton E.	H. Carscallen, Opp.
Hamilton West	J. S. Hendrie, Opp.
Hastings East	S. Russell, Govt.
Hastings North	J. W. Pearce, Opp.
Hastings West	M. B. Morrison, Opp.
Huron East	A. Hislop, Govt.
Huron South	Henry Eilber, Opp.
Huron West	M. G. Cameron, Govt.
Kent East	John Lee, Govt.
Kent West	T. L. Pardo, Govt.
Kingston	E. J. B. Pense, Govt.
Lambton East	H. J. Pettypiece, Govt.
Lambton West	W. J. Hanna, Opp.
Lanark North	W. C. Caldwell, Govt.
Lanark South	A. J. Matheson, Opp.
Leeds	Walter Beatty, Opp.
Lennox	Thos. G. Carscallen, Opp.
Lincoln	Dr. E. Jessop, Opp.
London	A. Beck, Opp.
Manitoulin	R. R. Gamey, Opp.
Middlesex East	Dr. G. Routledge, Govt.
Middlesex North	W. H. Taylor, Govt.
Middlesex West	Hon. G. W. Ross, Govt.
Monck	Hon. R. Harcourt, Govt.
Muskoka	Arthur A. Mahaffey, Opp.
Nipissing East	Dr. M. James, Govt.
Nipissing West	Jos. Michaud, Govt.
North Norfolk	Arch. Little, Govt.
Norfolk South	W. A. Charlton, Govt.
Northumbeland E.	Dr. Willoughby, Opp.
Northumberland W.	Sam. Clarke, Govt.
Ontario North	W. H. Hoyle, Opp.
Ontario South	Hon. John Dryden, Govt.
Ottawa	C. B. Powell, D. Murphy, Opp.
Oxford North	James Munro, Govt.
Oxford South	D. Sutherland, Opp.
Parry Sound	Milton Carr, Govt.
Peel	John Smith, Govt.
North Perth	John Brown, Govt.
Perth South	Valentine Stock, Govt.
Peterboro' East	Wm. Anderson, Govt.
Peterboro' W.	Hon. J. R. Stratton, Govt.
Port Arthur & R. R.	Jas. Conmee, Govt.
Prescott	Hon. F. Evanturel, Govt.

Prince Edward .. Dr. M. Currie, Govt.
North Renfrew.....A. E. Dunlop, Opp.
Renfrew S. ..Hon. F. R. Latchford, Govt.
Russell .. ..O. Guibord, Govt.
Sault Ste. Marie...Chas. N. Smith, Govt.
Simcoe Centre .. David Davidson, Govt.
Simcoe East .....J. B. Tudhope, Govt.
Simcoe West ..... J. S. Duff, Opp.
Stormont ..... W. J. McCart, Govt.
Toronto East .... Dr. R. A. Pyne, Opp.
Toronto North.Dr. Beattie Nesbitt, Opp.
Toronto South ..... J. J. Foy, Opp.
Toronto West .. Thos. Crawford, Opp.
Victoria East .. J. H. Carnegie, Opp.
Victoria West ..... S. J. Fox, Opp.
Waterloo N. .. Dr. H. G. Lackner, Opp.
Waterloo South....W. A. Kribs, Opp.
Welland ..... J. F. Cross, Govt.
Wellington E..Hon. J. M. Gibson, Govt.
Wellington S. ... J. P. Downey, Opp.
Wellington W. .. James Tucker, Opp.
Wentworth N. .. R. A. Thompson, Govt.
Wentworth S. .. John Dickenson, Govt.
York East .... John Richardson, Govt.
York North .... Hon. E. J. Davis, Govt.
York West .... J. W. St. John, Opp.

PROVINCE OF QUEBEC.

Entered Confederation 1st July, 1867.

Lieutenant-Governor, the Hon. Judge Jette, $10,000; Capt. H. F. Sheppard, Aide de Camp; Alphone Genereux, private secretary; Walter Lannen, messenger.

Population, 1901—1,648,898

Seat of Government—Quebec.

Executive Council.

Hon. S. N. Parent, Premier and Minister of Lands, Mines, and Fisheries.
Hon. H. Archambeault, Attorney-General.
Hon. A. Turgeon, Minister of Agriculture.
Hon. Amedee Robitaille, Secretary and Registrar.
Hon. John C. McCorkill, Provincial Treasurer.
Hon. J. J. Guerin, without portfolio.
Hon. L. Gouin, Minister of Colonization and Public Works.
Hon. W. S. Weir, without Portfolio.

Officers—G. Grenier, Clerk Executive Council; W. Learnmouth and A. Genereux, clerks, and one messenger.

Officers of the Legislative Council.

Speaker, Hon. Horace Archambeault.
Clerk, Louis Frechette.
Gentleman Usher of the Black Rod, vacant.
Clerk Assistant, R. Campbell.
Clerk of English Journal and English Translator, R. Campbell.
Clerk of French Journal and French Translator, Nap. Legendre.
Sergeant at Arms and Clerk of Committees, J. E. Baribeau.

Officers of the Legislative Assembly.

Speaker, Hon. H. B. Rainville, M.P.P.
Clerk of the Legislative Assembly, L. G. Desjardins.
Sergeant-at-Arms, Ed. Laliberte.
Assistant Sergeant at Arms, J. A. Delisle.
Assistant Clerk of the Legislative Assembly, A. C Guilbault.
Clerk of the English Journal and Records, E. R. Alleyn.
Assistant Clerk of English Journal, Alfred K. Austin.
Clerk of French Journal and Petitions, etc., L. N. Patenaude.
Assistant Clerk of French Journal and Petitions, etc., Geo. Watters.
Accountant, Laurent Simoneau.
Assistant Accountant and Permanent Copying Clerk, W. Deschambault.
Clerk of the Private Bills Committee and Permanent Orders, Charles Delagrave; Clerk of Committee, F. L. Desaulniers.
Assistant French Translators, Ernest Tremblay, Honore Joanette, Ernest Chouinard.
Chief English Translator, Crawford Lindsay.
Assistant English Translators, J. A. Jordan and P. W. Langlois.
Clerk of Votes and Proceedings, Achillas Mercier.
Assistant Clerk of Votes and Proceedings, Ant. Tachereau.
Assistant Clerk of Committees, Antonio Couillard.
Clerk of Printing and Records, Chs. Pageau.
Stationery, Patrick Kerwin.
Postmaster, Zenophile Benoit.
Assistant Postmaster, Victor Lacroix.
Joint Chief Copying Clerk, P. P. Daunais.
Clerk in Chancery, L. G. Desjardins.

Library.

Joint Librarians, N. E. Dionne and A. G. Doughty.
Clerks, Joseph Trudel and Joseph Desjardins.

Law Clerk's Office.

Law Clerk, L. J. Cannon.
Special Officers at Law, T. H. Oliver, K.C., C. Lanctot, K.C.

PROVINCIAL REGISTRAR'S OFFICE.

Provincial Registrar, Hon. A. Robitaille.
Deputy Registrar, Joseph Boivin.
Clerks of Archives and Registration, Endore Evantural and A. Simard.

DEPARTMENT OF COLONIZATION AND PUBLIC WORKS.

Minister, Hon. L. Gouin.
Deputy Minister, Simeon LeSage.
Secretary, Ernest Gagnon.
Engineer and Superintendent of Public Works, Elizear Charest.
Assistant Engineer, T. A. Trudelie.
Accountant, A. Gagnon.
Assistant Accountant, M. Brassard.
Director of Railways, L. A. Vallee.
Secretary Railway Office, J. A. Lefebvre.
Clerks, Claude Denechaud, J. B. Gosselin.
Registrar, F. X. Boileau.
Deputy Registrar, J. E. Garneau.
Clerk, Joseph Roy.
Draughtsmen, G. St. Michel and L. P. Vallerand.
Stenographer, Alphonse Gagnon.
Private Secretary, O. Asselin.

Colonization Branch.

Deputy Minister, S. Dufault.
Secretary Colonization Work, J. F. Savary.
Inspector, J. N. Gastonguay.
Clerks, E. Gauvreau, T, Sheehan.

SECRETARY'S OFFICE.

Provincial Secretary, Hon. A. Robitaille.
Deputy Secretary, Joseph Boivin.
Private Secretary, Auguste Edge.
Inspector of Registry Offices, A. Geoffrion.
Inspectors of Public Offices, Jails and Asylums, A. L. de Martigny, M.D., and John Wood, M.D.
Chief Clerk, Joseph Dumont.
English Correspondence, T. J. Molony.
Recording Clerk, Ernest Myrand.
Clerks of Statistics and Clerks of Accounts for Lunatic Asylums, Reformatory and Industrial Schools, Art. Talbot, T. Nap. Pelletier, and E. Dorion.
Clerks of Statistics, Department Reports, Returns to Orders and Addresses of the Legislature, E. H. Bisson.
Accountant, Felix Campeau.
Clerks, E. Mallette, P. Gagnon, J. F. Forgues and J. O. Montreuil.

DEPARTMENT OF LANDS, MINES, AND FISHERIES.

Minister, Hon. S. N. Parent.
Assistant Minister, Eugene E. Tache.
Accountant, V. Derome.
Assistant Accountant, James Creighton.
Clerk, A. Marcotte.
Superintendent of Woods and Forests, P. Blouin.
Clerks, William Delaney, W. H. Hatch, P. R. Plamondon, W. C. J. Hall.
Superintendent of Land Sales, C. O. Lavoie.
Eugene Rouillard, Secretary.
Clerks, J. Grenier, Henry Thomson and
Clerks, J. M. Turcot, A. Dumais, J. O. Martineau, A. Bedard.
C. Lanctot, K.C.
Controller of Stationery, J. A. Bellisle.
Registrar, B. Duval.
Assistant Registrar, L. H. B. Garneau.
Superintendent of Fisheries and Game, Hector Caron.
Clerk, E. Hamel.
Law Clerk, J. Bouffard.
Stenographer, J. A. Belisle.
Clerk, T. Rinfret.
Private Secretary.
Messengers, C. Cote, A. Lacasse and Em. Clavet.

Crown Timber and Land Agents

Roberval, G. Audet.
Carleton W., N. Arseneau.
Rimouski, Aug. Lavoie.
Saint Roch, Q., J. E. Boily.
Thurso, J. A. Cameron.
Gaspe Basin, John Carter.
Morehead, W. Clarke.
Maniwaki, R. M. Gendron.
Cheneville, Hercule Chene.
Ste. Claire, J. E. Cayouette.
St. Jovite, T. A. Christin.
Tadousac, Eug. Caron.
Joliette, J. A. Martin.
St. Francis, Beauce, W. B. C. De Lery.
Hebertville, S. Dumais.
Hull, F. A. Gendron.
Grenville, A. B. Filion.
Matane, A. Fraser.
Perce, J. A. L. Espirance.
Arthabaskaville, J. A. Doucet.
Bais des Peres, A. E. Guay.
Quebec, Philippe Huot, Jesuits Estates Agent, Felix Lakue.
Waterloo, O. B. Kemp, Inspector of Agencies.
Three Rivers, John Ryan, Timber Agent: L. A. Lord, Land Agent.
Montreal, J. E. Clement.
N. D., Levis, E. Lemieux, Seigniory of Lauzon, Agent.
L. Metapedia, F. Saucier.
Fraserville, N. Lebel.
St. Agathe des Monts, E. J. Marchand.

New Carlisle, W. Maguire.
Sherbrooke, Jacques Picard.
St. Felicien, Arth. Poliquin.
Cap Chat, Delphis Roy.
Gracefield, A. Synek.
Chicoutimi, J. A. Cleaveau.
Mailloux, L. J. Turgeon.
Montmagny, Charles F. Leclerc.
Grindstone, D. V. Bourque.

KING'S PRINTER'S OFFICE.

King's Printer, Charles Pageau.
Clerk, Ed. Trudelle.
Clerk, Jos. G. Gingras.

DEPARTMENT OF THE ATTORNEY-GENERAL.

Attorney-General, Hon. Horace Archambeault, K.C.
Deputy Attorney-General, L. J. Cannon, K.C.
Private Secretary, O. J. Morin.
Special Law Officers, T. H. Oliver, K.C., and C. Lanctot, K.C.
Inspector of Registry Offices, Aime Geoffrion.
Clerks, E. Lortie, Oscar Morin, St. George Legendre, E. L. Pacaud.

TREASURY DEPARTMENT.

Treasurer, Hon. H. T. Duffy.
Assistant Treasurer and Secretary of Treasury Board, H. T. Machin.
Bookkeeper, Alex. Hyde.
Stenographer, R. H. O'Regan.
Minister's Private Secretary, Art. Doughty.
Audit Branch—Provincial Auditor, A. H. Verret.
Bookkeeper, G. V. Tessier.
Revenue Branch—Comptroller, A. Brosnan; Inspector, T. A. Preston.

DEPARTMENT OF PUBLIC INSTRUCTION.

Superintendent of Public Instruction, Hon. P. Boucher de La Bruere, D.C.L.
French Secretary of the Department, Paul de Cazes.
English Secretary of the Department, George W. Parmelee.
Special Officer, J. N. Miller.
Curator of the Museum, Dr. L. Larue.
Accountant, John Strang.
Clerk of Statistics, F. Couillard.
Recording Clerk, L. J. Prejen.
Librarian and French Correspondence, M. Raymond.
Clerk of English Correspondence, W. G. L. Paxman.
Clerk of Accounts, L. Lefebvre.
Assistant Bookkeeper, Charles Blanchet.
Clerks, A. Dessane, C. Levesque, A. Dore and F. S. Lee.

DEPARTMENT OF AGRICULTURE.

Minister, Hon. A. Turgeon.
Deputy Minister, George Auguste Gigault.
Secretary, S. Sylvestre.
Secretary of Council of Agriculture, Oct. Oucillette.
Accountant, A. M. Fleury D'Eschambault.
Assistant Accountant, J Arthur Paquet.
Registrar, N. O. Demers.

BOARD OF HEALTH, PROVINCE OF QUEBEC.

Offices: 76 St. Gabriel Street, Montreal.
Members—Dr. E. Persillier-Lachapelle, Mr. Henry R. Gray, Dr. Robert Craik, Dr. J. I. Desroches, Dr. Laurent Catellier, Dr. W. A. Verge, Dr. Pantaleon Pelletier.
Officers—Dr. E. Persillier-Lachapelle, president; Dr. Elzear Pelletier, secretary; Dr. J. A. Beaudry, inspector; Dr. Wyatt Johnston, bacteriologist; Dr. R. F. Ruttan, chemist, Montreal; Dr. Paul E. Prevost, recorder of vital statistics.

LIST OF MEMBERS OF THE LEGISLATIVE ASSEMBLY.

Argenteuil—Hon. Wm. Alex. Weir., Montreal.
Arthabaska—Paul Tourigny, Victoriaville.
Bagot—F. H. Daignault, Acton.
Beauce—Jos. Arth. Godbout, St. George.
Beauharnois—Achille Bergevin, Montreal.
Bellechasse—Hon. Adelard Turgeon, Quebec.
Berthier—Vacant.
Bonaventure—W. H. Clapperton, Maria.
Brome—Hon. J. C. McCorkill, Cowanville.
Chambly—Maurice Perrault, Longueuil.
Champlain—Pierre C. Neault, Grand Mere.
Charlevoix—Joseph Morin, Baie St. Paul.
Chateauguay—F. X. Dupuis, Montreal.
Chicout. et Sag—Honore Petit, Ste. Anne de Chicoutimi.
Compton—Allen Wright Giard, La Patrie.
Deux-Montagnes—Hector Champagne, St. Eustace.
Dorchester—Hon. L. P. Pelletier, Quebec.
Drummond—Jos. Laferte, St. Germain de Grantham.
Gaspe—Xavier Kennedy, Douglastown.
Hochelaga—D. J. Decarie, Notre Dame de Grace.
Huntingdon—William H. Walker, Huntingdon.
Iberville—Frs. Gosselin, St. Alexandre.
Iles de la Madel—Patrick P. Delaney, Havre-aux-Maisons.

Jacques-Cartier—Joseph A. Chauret, Ste. Genevieve.
Joliette—Joseph M. Tellier, Joliette.
Kamouraska—L. Rodolphe Roy, Quebec.
Lac St. Jean—George Tanguay, Quebec.
Laprairie—Come S. Cherrier, Laprairie.
L'Assomption—Joseph E. Duhamel, L'Assomption.
Laval—Hon. Pierre E. LeBlanc, Montreal.
Levis—J. Cleophas Blouin, N. D. de-la-Victoire.
L'Islet—Jos. Ed. Caron, Ste. Louise.
Lotbiniere—Napoleon Lemay, Ste. Croix.
Maskinonge—Vacant.
Matane—Donat Caron, St. Octave de Metis.
Megantic—George R. Smith, Kingsville.
Missisquoi—Joseph J. B. Gosselin, Stanbridge.
Montcalm—P. J. L. Bissonnette, St. Esprit
Montmagny—Ernest Roy, Quebec.
Montmorency—L. A. Taschereau, Quebec.
Montreal No. 1—Geo. A. Lacombe, Montreal
Montreal No. 2—Hon. Lomer Gouin, Montreal.
Montreal No. 3—Hon. H. Benj. Rainville, Montreal.
Montreal No. 4—James Cochrane, Montreal.
Montreal No. 5—Matthew Hutchinson, Montreal.
Montreal No. 6—Hon. J. J. Ed. Guerin, Montreal.
Napierville—Cyprien Doris, St. Michel-Archange.
Nicolet—Hon. E. J. Flynn, Quebec.
Ottawa—Chas. B. Major, Papineauville.
Pontiac—David Gillies, Breaside, Ont.
Portneuf—Vacant.
Quebec Centre—Hon. A. Robitaille, Quebec
Quebec County—Cyr. F. Delage, Quebec.
Quebec East—Jules Alfred Lane, Quebec.
Quebec West—John Gabriel Hearn, Quebec.
Richelieu—L. P. P. Cardin, Montreal.
Richmond—P. S. G. Mackenzie, Melbourne.
Rimouski—Auguste Tessier, Rimouski.
Rouville—Alfred Girard, Marieville.
St. Hyacinthe—Joseph Morin, St. Hyacinthe.
St. Jean—Philippe Honore Roy, St. Jean.
St. Maurice—Louis Philippe Fiset, St. Boniface (Shawenegan).
St. Sauveur—Hon. S. N. Parent, Quebec.
Shefford—Vacant.
Sherbrooke—Pantaleon Pelletier, Sherbrooke.
Soulanges—A. Bissonnette, St. Joseph de Soulanges.
Stanstead—Geo. H. St. Pierre, Coaticook.
Temiscouata—Napoleon Dion, Fraserville.
Terrebonne—J. J. B. Prevost. St. Jerome.
Trois-Rivieres—Rich. Stanislas Cooke, Trois Rivieres.
Vaudreuil—Hormisdas Pilon, St. Michael de Vaudreuil.
Vercheres—Etienne Blanchard, St. Marc.
Wolfe—Jerome A. Chicoyne, Sherbrooke.
Yamaska—Louis-Jules Allard, St. Fran. du Lac.

NEW BRUNSWICK

Entered Confederation, 1st July, 1867.

Population, 1891, 321,294; 1901, new census, about 331,130.

Seat of Government—Fredericton.

Lieutenant-Governor, the Hon. Jabez Bunting Snowball, $9.000 ; Aides-de-Camp, Lieut.-Col. Hugh H. McLean, 62nd Fusiliers, St. John; Lieut.-Col. Robert Randolph Call, Artillery Reserve, Newcastle, and J. J. Fraser, Captain, 71st Regiment, Fredericton.
Private Secretary, R. S. Barker.

Executive Council.

Premier, Provincial Secretary, and Receiver-General, Hon. Lemuel J. Tweedie $2,100
Surveyor-General, Hon. A. T. Dunn 1,700
Attorney-General, Hon. William Pugsley 2,100
Commissioner for Agriculture, Hon. Lauchlan P. Farris 1,700
Chief Commissioner of Public Works, Hon. C. H. La Billois...
Members of Council, Hon. H. A. McKeown and Hon. Francis J. Sweeney.... ... .
Clerk, J. H. Dickson.....
Agent-General, C. A. D. Miller, London, England .....

PROVINCIAL SECRETARY'S OFFICE.

Provincial Secretary and Receiver-General, Hon. J. L. Tweedie. $2,100

Deputy Provincial Secretary and Deputy Registrar-General, R. W. L. Tibbits, and King's Printer.... 1,800
Deputy Receiver-General, G. N. Babbitt.... 1,800
Clerks, C. Sterling Brannen, $850; John Donahoe, $500, and S. W. Babbitt, $450.

SURVEYOR-GENERAL'S DEPARTMENT.

Deputy Surveyor-General, W. P. Flewelling $1,600
Chief Draughtsman, T. G. Loggie. 1,600
Assistant Draughtsman, R. S. Barker 1,100
Clerk, F. Saddler 500
Stenographer, Miss F. Tibbits 500

BOARD OF WORKS DEPARTMENT.

Chief Commissioner, Chas. H. LaBillois $1,700
Secretary to Board of Works, T. B. Winslow 1,600
Engineer, A. R. Wetmore 2,000
Clerk, G. Fred Coy 700
Stenographer, Peter Hughes.... 800
Draughtsman, Wm. Harrison .. 1,200
Draughtsman, C. A. McVey.... 600

DEPARTMENT OF AGRICULTURE.

Commissioner, Hon. L. P. Farris..$1,700
Deputy Commissioner, Thomas A. Peters.... 1,500

DEPARTMENTAL OFFICERS.

Auditor-General, James S. Beck..$1,700
Wilson, A. Loudoun.... 800
Clerk of the Pleas, T. Carlton Allen 2,200
Deputy Clerk of the Pleas, Ernest McKay 600
Librarian, Abram A[illegible] 500
Caretaker Parliament Building, John Lister 600
King's Printer, R. W. L. Tibbitts.

NOVA SCOTIA

Entered Confederation, 1st July, 1867.
Population, 1901,459,574.
Seat of Government—Halifax.
Lieutenant-Governor (and Deputy-Governor for signing Marriage Licenses), The Honorable Alfred Gilpin Jones, $9,000 ; G. Carleton Jones, Private Secretary.

Executive Council.

Premier and Provincial Secretary, Hon. G. H. Murray $4,000
Attorney-General, Hon. J. W. Longley 3,200
Commissioner of Works and Mines, Hon. Arthur Drysdale.. 3,200
Members without office, Hon. A. H. Comeau, Hon. T. R. Black, Hon. D. McPherson, Hon. W. T. Pipes, Hon. C. P. Chisholm.
Retired members of Executive Council retaining their rank and precedence, by special permission of Her Majesty, Sir Charles Tupper, G.C.M.G.; Hon. James McDonald, Hon. Alexander McFarlane.
President of Legislative Council, Hon. Robert Boak.
Clerk of Legislative Council, A. G. Troop.

Speaker of Legislative Assembly, Hon F. A. Lawrence.
Clerk of Legislative Assembly (vacant).

CROWN LANDS DEPARTMENT.

Commissioner of Crown Lands, the Attorney-General.
Chief Clerk, James H. Austen.

DEPARTMENT OF PROVINCIAL SECRETARY.

Provincial Secretary and Treasurer, Hon. G. H. Murray.
Deputy Secretary, F. F. Mathers.
Marriage License Clerk, J. B. Currie.
Provincial Cashier, John MacAloney.
Registrar of Joint Stock Companies, Fred W. Dunn.

AGRICULTURE.

Secretary for Agriculture, B. W. Chipman.
Provincial Veterinary Surgeon, William Jakeman.

DEPARTMENT OF PUBLIC WORKS AND MINES.

Commissioner, Hon. Arthur Drysdale.
Deputy Commissioner and Inspector of Mines, Edwin Gilpin, jr.
Provincial Engineer, Martin Murphy.
Provincial Hospital for Insane—Medical Superintendent, W. H. Hattie, M. D. Victoria General Hospital—Superintendent, W. W. Kenny. Provincial Library—Librarian, F. Blake Crofton.

COUNCIL OF PUBLIC INSTRUCTION.

The Executive Council, Secretary, A. H. MacKay, B.A., LL.D., I.R.S.C.

PRINCE EDWARD ISLAND

Entered Confederation, 1st July, 1873.

Population, 1901, 103,259.

Seat of Government—Charlottetown.

Lieutenant-Governor, Hon Peter A. McIntyre $7,000

Executive Council.

President and Premier and Attorney-General, Hon. Arthur Peters.

Provincial Secretary - Treasurer and Commissioner of Agriculture, Hon. Benjamin Rogers.

Commissioner of Public Works, Hon. James H. Cummiskey.

Members of Council, Hon. James W. Richards, Hon. Peter McNutt, Hon. R. C. McLeod, Hon. George Forbes. Hon. John F. Whear, Hon. George W. Simpson.

Clerk, Arthur Newbery $200

Provincial Government Officers.

Attorney-General, Hon. Arthur Peters..... ... ...$1,200

Provincial Secretary - Treasurer and Commissioner of Agriculture, Hon. Benjamin Rogers.... 1,200

Assistant Provincial Secretary - Treasurer, A. Newbery 1,000

Clerk, J. D. McMillan 500

Clerk, Isidore Buote 500

Clerk, Miss M. Smith 420

Commissioner of Public Works, Hon. James H. Cummiskey..... 1,200

Secretary of Public Works, Louis B. McMillan 1,000

Draughtsman, H. C. McMillan ... 600

Provincial Auditor, Benjamin Balderston.. 1,200

Chief Superintendent of Education, Alexander Anderson, LL.D. 1,200

Clerk to Superintendent of Education, R. S. Farquharson..... 700

Official Court Stenographer Legislative Librarian, and Secretary to Premier and Attorney-General, William H. Crosskill..... 1,000

Typewriter, Miss M. Hughes 300

Registrar of Deeds, Charlottetown, and Commissioner of Public Lands, William C. White.. 1,200

Registrar of Deeds, Summerside, Joseph Murphy..... 600

Assistant Registrar of Deeds, Charlottetown, Michael Laverty 600

Clerk A. Callaghan,

Clerk, John C. McKenzie 500

Draughtsman, Thomas May 300

Secretary to Department of Agriculture, and Superintendent of Farmers' Institutes, Ewen McMillan.... 800

Keeper Provincial Building, Duncan Kennedy 400

LIST OF MEMBERS OF THE LEGISLATIVE ASSEMBLY, P.E.I., 1903.

John Kickham, C., representing 1st District King's Co. (C); post-office address, Souris East.

John McLean, A., 1st District King's Co., (C.), post-office address, Souris.

Vacant—2nd District of King's vacant.

Vacant—3rd District of King's.

Hon. Arthur Peters, A., 2nd District King's County, (L.), post-office address, Charlottetown.

James E. McDonald, C., 3rd District King's County, (C.), Cardigan.

W. A. O. Morson, K.C., A., 3rd District King's County, (C.), post-office address, Charlottetown.

Murdock McKinnon, C., 4th District King's County, (C.), post-office address, Valleyfield.

John A. Mathieson, A., 4th District King's County, (C.), Georgetown.

Hon. Daniel Gordon, C., 5th District King's County, (C.), post-office address, Georgetown.

Archd. J. McDonald, A., 5th District King's County, (C.), post-office address, Georgetown.

George W. Simpson, C., 1st District Queen's County, (L.), post-office address, Bay View.

Matthew Smith, C., 1st District Queen's County, (L.), post-office address, Hampton.

Dugald Currie, C., 2nd District Queen's County, (C.), post-office address, Long Creek.

A. E. Douglas, M.D., A., 2nd District Queen's County, (L.), post-office address, Hunter River.

Hon. J. H. Summiskey, C., 3rd District Queen's County, (L.), post-office address, Charlottetown.

H. James Palmer, A., 3rd District Queen's County, (L.), post-office address, Charlottetown.

Hon. Geo. Forbes, C., 4th District Queen's County, (L.), post-office address, Vernon River Bge.

David P. Irving, A., 4th District Queen's County, (L.), post-office address, Vernon River Bge.

George E. Hughes, C., 5th District Charlottetown, (L.), post-office address, Charlottetown.
Hon. John F. Whear, A., 5th District Charlottetown, (L.), post-office address, Charlottetown.
Hon. Benjamin Rogers, C., 1st District Prince County, (L.), post-office address, Alberton.
Benjamin T. Gallant, A., 1st District Prince County, (L.), post-office address, Bloomfield.
A. McWilliam, C., 2nd District Prince County, (L.), post-office address, West Cape.
Hon. J. W. Richards, A., 2nd District Prince Co., (L.), post-office address, Bideford.
Hon. Peter McNutt, L., 3rd District Prince County, (L), post-office address, Malpeque.
J. Felix Arsenault, A., 3rd District Prince County, (C.), post-office address, Wellington.
Capt. Joseph Read, C., 4th District Prince County, (L.), post-office address, Summerside.
Hon. S. E. Reid, A., 4th District Prince County, (L.), post-office address, Tryon.
Hon. R. C. McLeod, C., 5th District Prince County, (L.), post-office address, Summerside.
George Godkin, A., 5th District Prince County, (L.), post-office address, Summerside.

MANITOBA

Entered Confederation, July 15, 1870.
Population, 1902, 254,947.
Seat of Government—Winnipeg.
Lieutenant-Governor, Hon. Sir Daniel Hunter McMillan, K.C.M.G.
Private Secretary, Gordon Thompson.

PROVINCIAL EXECUTIVE.

Hon. R. P. Roblin, Premier, President of Council, Railway Commissioner, and Minister of Agriculture and Immigration.
Hon. J. H. Agnew, Provincial Treasurer.
Hon. D. H. McFadden, Provincial Secretary and Municipal Commissioner.
Hon. Colin H. Campbell, Attorney-General, Municipal Commissioner, and Minister of Education.
Hon. Robert Rogers, Minister of Public Works.
Ch. Graburn, Clerk Executive Council.
W. J. Ptolemy, Chief Clerk Treasury Department.
George A. Simpson, Chief Clerk Public Works Department.
Hugh McKellar, Chief Clerk Department Agriculture and Immigration.
James Hooper, Chief Clerk Provincial Secretary's Department and King's Printer.
George Patterson, Chief Clerk Attorney-General's Department.
R. Fletcher, B.A., Chief Clerk, Education Department.
J. P. Robertson, Librarian.
George Black, Auditor.
E. M. Wood, Chief Clerk, Municipal Commissioner and Railway Department.
E. J. Elliott, Chief of Provincial Police.

DEPARTMENT OF EDUCATION.

Hon. R. P. Roblin, Hon. J. A. Davidson, Hon. D. H. McFadden, Hon. C. H. Campbell, Hon. Robert Rogers, Chief Clerk, R. Fletcher, B.A.
Advisory Board—His Grace Archbishop of Rupert's Land, Chairman; R. Fletcher, B.A.; Secretary, Rev. Thos. Hart, M.A., B.D., Win.; Rev. A. A. Cherrier, Win.; J. R. Jones, M.D.; Rev. Canon Matheson; Prof. R. R. Cochrane, B.A.; D. McIntyre, M.A., Winnipeg; J. D. Hunt, B.A., Carberry.

COURT OF KING'S BENCH.

Chief Justice, Hon. J. Dubuc.
Puisne Judges, Hon. J. F. Bain, Hon. A. E. Richards, Hon. W. E. Perdue.

MEMBERS AND OFFICERS OF THE LEGISLATURE.

A. H. Corelli, Clerk Legislative Assembly.
J. Macdougall, Sergeant-at-Arms.
Arthur (Con), A. E. Thompson, Melita.
Assiniboia (Lib), Joseph Prefontaine, St. Francois Xavier.
Avondale (Con.), Jas. Argue, Elgin.
Beautiful Plains (Con.), Hon. J. A. Davidson, Winnipeg.
Birtle (Lib.) Chas. J. Mickle, Birtie.
Brandon City (Con.), Dr. S. W. McInnis, Brandon.
Carillon (Con.), Albert Prefontaine, St. Pierre.
Cypress (Con.), Geo. Steel, Glenboro'.
Dauphin (Con.), Dr. J. R. Gunne, Dauphin.
Deloraine (Con.), Edward Briggs, Deloraine.
Dufferin (Con.), Hon. R. P. Roblin, Winnipeg.
Emerson (Con.), Hon. D. H. McFadden, Emerson.

Gilbert Plains (Con.), Glen. Campbell, Glenvon.
Gimli (Con.), B. L. Baldwinson, Winnipeg.
Gladstone (Con.), David Wilson, Winnipeg.
Hamiota (Lib.), David Jackson, Hamiota.
Kildonan-St. Andrew (Lib.), M. J. O'Donahoe, Selkirk.
Killarney (Con.), Geo. Lawrence, Killarney.
Lakeside (Con.), E. D. Lynch, Westbourne.
Lansdowne (Con.), Dr. H. E. Hicks, Oak Lake.
La Verandrye (Lib.), W. Lagimodiere, Lorette.
Manitou (Con.), Hon. Robt. Rogers, Winnipeg.
Minnedosa (Con.), W. B. Waddell, Minnedosa.
Morden (Con.), J. H. Ruddell, Morden.
Morris (Con.), Hon. Colin H. Campbell, Winnipeg.
Mountain (Lib.), Hon. T. Greenway, Crystal City.
Norfolk (Con.), R. F. Lyons, Carberry.
Portage la Prairie (Con.), Hugh Armstrong, Portage la Prairie.
Rhineland (Lib.), V. Winkler, Morden.
Rockwood (Con.), I. Riley, Stonewall.
Russell (Lib.), W. J. Doig, Russell.
St. Boniface (Lib.), H. Chevier, St. Boniface.
South Brandon (Con.), A. H. Carroll, Carroll.
Springfield (Con.), W. H. Corbett, Springfield.
Swan River (Con.), James W. Robson, Swan River.
Turtle Mountain (Con.), James Johnson, Boissevain.
Virden (Con.), J. H. Agnew, Virden.
Winnipeg Centre (Con.), T. W. Taylor, Winnipeg.
Winnipeg North (Con.), S. Walker, Winnipeg.
Winnipeg South (Con.), J. T. Gordon, Winnipeg.

NORTH-WEST TERRITORIES

Lieutenant-Governor, Amedee Emmanuel Forget, $7,000.
Executive Council—F. W. G. Haultain, $4,000, President of Council, Attorney-General, Commissioner of Education, and Territorial Treasurer; G. V. Bulyea, $3,500, Commissioner of Public Works and Territorial Secretary; W. Elliott, $3,500, Commissioner of Agriculture; J. A. Reid, Clerk of Council and Government Printer.
Deputy Attorney-General, Horace Harvey, $2,300.
Assistant Territorial Secretary (acting), E. J. Wright, $1,500.
Assistant Treasurer, J. A. Reid, $2,000.
Deputy Commissioner of Public Works, B. J. Saunders, D.L.S., B.Sc., $2,000
Deputy Commissioner of Agriculture, J. R. C. Honeyman, $1,500.
Clerk Legislative Assembly, Spencer Page.
Educational Council: Rev. Father Gillis, A. H. Smith, B.A., N. D. Beck, B.A., J. Short, B.A., R. C. Willis, B.A.

LIST OF MEMBERS OF LEGISLATURE.

Banff, C. W. Fisher, Cochrane, Alta.
Batoche—Charles Fisher, Duck Lake, Sask.
Battleford—Benjamin Prince, Battleford, Sask.
Calgary East—J. J. Young, Calgary, Alb.
Calgary West—R. B. Bennett, Calgary, Alb.
Cannington—E. C. McDiarmid, Manor, Assa.
Cardston—John Wm. Woolf, Cardston.
Edmonton—R. Secord, Edmonton.
Grenfell—R. S. Lake, Grenfell, Assa.
High River—R. A. Wallace, High River, Alb.
Innisfail—John A. Simpson, Innisfail, Alb.
Kinistino—William Frederick Meyers, Kinistino, Sask.
Lacombe—P. Talbot, Lacombe, Alta.
Lethbridge—L. George De Veber, Lethbridge, Alta.
Macleod—F. W. G. Haultain, Regina, Assa.
Maple Creek—Horace A. Greeley, Maple Creek, Assa.
Medicine Hat—W. T. Finlay, Medicine Hat, Assa.
Mitchell—A. D. McIntyre, Rostehrn, Sask.
Moose Jaw—G. M. Annable, Moose Jaw, Assa.
Moosomin—Alexander Smith, Moosomin, Assa.
Prince Albert—Thomas McKay, Prince Albert, Sask.
Qu'Appelle North—Donald H. McDonald, Fort Qu'Appelle.
Qu'Appelle South—Geo. Hedley Vicars Bulyea, Regina, Assa.
Regina North—Geo. W. Brown, Regina, Assa.
Regina South—James B. Hawkes, Balgonie, Assa.
Saltcoats—Thomas McNutt, Saltcoats, Assa.
Saskatoon—James Clinkskill, Saskatoon.

Souris—J. W. Connell, Carnduff, Assa.
St. Albert—L. J. A. Lambert, St. Albert. Alb.
Strathcona—A. C. Rutherford, Strathcona, Alta.
Victoria—J. W. Shera, Fort Saskatchewan, Alb.
Wetaskiwin—A. S. Rosenroll, Wetaskiwin, Alta.
Whitewood—Archie B. Gillis, Whitewood, Assa.
Wolseley—W. Elliott, Regina, Assa.
Yorkton—Thos. A. Patrick, Yorkton, Assa.

BRITISH COLUMBIA

Entered Confederation July 20th, 1871.

Population, 1901—176,368.

Seat of Government—Victoria, V. I.

Lieutenant-Governor, Sir Henri Gustave Joly de Lotbiniere, K. C., M. G., $9,000; Private Secretary, R. B. Powell, $1,200.

Executive Council.

Chief Commissioner and Premier, Hon. Richard McBride 1,000
Provincial Secretary and Minister of Education, A. E. McPhillips, K.C. 4,000
Attorney-General, Charles Wilson K.C. 4,000
Minister of Finance and Agriculture, R. G. Tatlow 4,000
Chief Commissioner of Lands and Works, Hon. R. F. Green, Kaslo.. 4,000
Minister of Mines, R. McBride. New Westminstar 4,000

Attorney-General's Department.

Deputy Attorney-General, H. A. McLean 2,400
Registrar General of Titles and Registrar of Joint Stock Companies, S. Y. Wootten 2,400
District Registrar of Titles, New Westminster, C. S. Keith..... 1,800
District Registrar of Titles, Vancouver, T. O. Townley 2,280

Provincial Secretary's Department.

Prov. Secretary, A. E. McPhillips... 4,000
Deputy Provincial Secretary, A. C. Reddie 2,000
King's Printer and Controller of Stationery, R. Wolfenden 2,160

Treasury Department.

Minister of Finance, Hon. R. G. Tatlow 4,000
Deputy Treasurer, J. McB. Smith. 2,400
Auditor-General, J. A. Anderson. 2,100
Surveyor of Taxes and Inspector of Revenue, J. B. McKilligan..... 1,920

Lands and Works Department.

Chief Commissioner, Hon. W. C. Wells..... 4,000
Deputy Commissioner, W. S. Gore 2,400
Public Works Engineer, F. C. Gamble 2,400
Assistant to Chief Commissioner, W. McNeill 1,500
Chief Clerk, B. H. John 1,800

Department of Agriculture.

Deputy Minister of Department, J. R. Anderson 1,800
Inspector, R. M. Palmer..... 1,500

Educational Department.

Superintendent of Education, Alex. Robinson, B.A..... 2,100
Inspector of Schools, D. Wilson, B. A..... 1,680
Inspector of Schools, A. C. Stewart 1,560
Inspector of Schools, S. B. Netherby 1,440
Principal Normal School, W. Burns, B.A. 1,800
Assistant Master of Normal School, J. D. Buchanan 1,500
Drawing Master, David Blair.... 1,200

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POPULATION OF THE PRINCIPAL MUNICIPAL CITIES.

	1891	1901		1891	1901
Montreal	220,181	266,826	Victoria	16,841	20,821
Toronto	181,220	207,971	Kingston	19,263	18,043
Quebec	63,090	68,834	Brantford	12,753	16,631
Ottawa	44,154	59,902	Hull	11,264	13,988
Hamilton	48,980	52,550	Calgary	3,876	4,866
Winnipeg	25,639	42,336	Charlottetown	11,373	12,080
Halifax	38,495	40,787	Valleyfield	5,515	11,055
St. John	39,179	40.711	Sherbrooke	10,097	11,765
London	31,977	37,983	Sydney	2,427	9,908
Vancouver	13,709	26,196	Moncton	8,762	9,026
			Brandon	3,778	5,738

POPULATION OF CANADA

	Population 1901			Population in 1891		
	Total	Rural.	Urban.	Total.	Rural.	Urban.
	5,369,666	3.349,065	2,020,601	4,833,239	3,296,141	1.537,098
British Columbia	177,272	87,825	89,447	98,173	60,945	37,228
Manitoba	254,947	184,714	70,233	152,506	111 498	41,008
New Brunswick	33 ,12	253,835	77,285	321,26	272,36	48,901
Nova Scotia	459,574	33 ,191	129,383	450,396	373,403	76,993
Ontario	2,182,947	1,259,190	935,752	2,114,321	1,295,323	818,998
Prince Edward Island	103,259	88,304	14.955	109,078	94,823	14,755
Quebec	1,648,898	992,667	656,231	1,488,535	988,820	499,215
Northwest Territories	158,940	120,767	38,173	66,799	66,799	.....
Unorganized Territories	72.709	43 6 8	9.142	32.168	32.168	.....

THE CLIMATE OF MANITOBA AND NORTH-WEST TERRITORIES.

By R. F. STUPART
Director of the Dominion Meteorological Service.

At the present time, when thousands of immigrants are pouring into Canada, a knowledge of the climate of Manitoba and the North-West Territories is of considerable importance, and as the available meteorological observations at most stations extend over a period of nearly twenty years, we can at least form a fair estimate of the climatic changes. At Winnipeg the series of observations extends to thirty years, and by comparing the records from one part of the country with those of another we are aided much in our estimate.

First, considering the spring and summer seasons, they being the more important from an agricultural standpoint, it will be found, by reference to the accompanying tables, that spring usually opens a little earlier in Alberta, near the mountains, and in South-Western Assiniboia than it does further east in Assiniboia and in Manitoba, but that after early in May the more eastern districts become the warmer, and that the average temperature of the three summer months in Manitoba, taking Winnipeg as approximately indicating the climate of the Province, is some 5 degrees higher than during the same season at Calgary and Edmonton. An average daily maximum temperature in April of 53 degrees at Calgary, 52 degrees at Edmonton, 58 degrees at Medicine Hat, and 47 degrees at Winnipeg, indicates very clearly that April is truly a spring month, and verifies the oft-repeated statement that spring seeding is well under way or perhaps completed in April. The rapid upward trend of the temperature curve continues during May and June, and it is from the middle of May until the end of July that the heaviest rainfall occurs throughout the whole region under discussion; a rainfall nearly similar to that of Ontario and Quebec during the same period, and which, as a rule, is ample to insure successful crops. Bright, hot days may be confidently looked for during July and August, and very occasionally in these months temperatures exceeding 90° perhaps nearly 100°, are recorded, but the average mean maxima in July of 78° at Winnipeg, 76° at Qu'Appelle, 82° at Medicine Hat, 75° at Calgary, indicate a not unpleasant warmth, while the corresponding minima show that the nights are pleasantly cool. A fact of peculiar interest in connection with the climate of our North-West Territories is that the summer season in Athabasca and the Basin of the great Mackenzie River is nearly as warm as in Alberta. At Edmonton and Calgary the mean summer temperature is 59°, Dunvegan is 58°, Fort Chippewyan is 59°, Fort Simpson 57°. The explanation of this lies chiefly in the fact that the insolation, i.e., heat received from the sun, scarcely vares about mid-summer between the parallels of latitude 40 degrees and 60 degrees; the larger number of hours the sun is above the horizon in the higher latitudes very nearly balancing the effect of less direct solar radiation; and as after early May the snow has all disappeared we find the isothermal lines running nearly parallel with the Rocky Mountains. In the writer's opinion this far north-western portion of the Dominion, the Mackenzie River district, is a land of great promise, but it should be spied out and experiments in agriculture made before any extensive immigration is encouraged, and this for the reason that while the summers are warm, a rapid downward trend of the temperature curve is very noticeable after the middle of August, and frost is not uncommon before the close of that month. While as we have seen, the summer climate as regards temperature, in the Mackenzie River Basin and Alberta does not differ very greatly from that found in Manitoba, this cannot be said of the colder seasons. Southern Alberta has a much milder winter than any other portion of the Territories and the cold becomes greater to the eastward over Assiniboia and Manitoba, and also northward towards Athabasca and the Mackenzie Basin. Eastwardly from Alberta the average winter temperatures, December-March, are as follows: Calgary, 17.1; Medicine Hat, 16.4; Qu'Appelle, 5.0; Winnipeg, 1.7 Northward the change is even more rapid, and in strong contrast to the

small variation during the summer; Calgary 17°; Edmonton, 13° below zero; Dunvegan, 1°; Fort Chippewyan, 5° below; Hay River, at the entrance of Slave Lake, 9° below; Fort Simpson, in latitude 62 degrees, 13° below; and Fort Good Hope near the Arctic Circle, 25° below. Seeing that the winters are so cold in the far northern Territories while the summers are warm, the time of the opening of spring becomes all-important, and the average date cannot be placed much before quite the end of April in the Peace River valley and early May further north in the Mackenzie Basin. All through April, however, the snow is melting fast and the temperature is frequently above 50 degrees; wild fowl are flying during the latter half of the month. Another feature of peculiar interest in connection with the climate of the Territories near the mountains is the rapid changes of temperature, which in winter frequently occur in short intervals of time; also the marked variableness of the mean winter temperature in different years, and the variableness of rainfall during the summers of different years. The phenomena of the rapid changes in short intervals is accounted for and explained in the well-known Chinook or Fohn effect, which is met with to a greater or lesser extent under the lee of mountains, on the windward side of which moisture is precipitated. We know that the moist ocean winds, which are forced up the western slopes of the mountain, owing to the condensation of moisture, do not cool as rapidly as they otherwise would, and subsequently, mechanical heating by compression as they descend the western slopes brings them to the prairie comparatively warm and dry. It is when a cyclonic area from the Pacific, moving across Northern Alberta, causes a rapid south-west and westerly flow of air across the Rocky Mountains that the Chinook blows over our western prairies. Sometimes a change of wind from north and north-east to south-westerly will in Alberta mean a rise of temperature from perhaps 20 degrees below zero to 40 degrees above in a few hours.

The variableness of seasons, while not entirely is certainly to a very great extent due the varying position of the mean track of storm centers in different years. The average mean track for January, deduced from many years, is across British Columbia, but in some winters the centers persistently move farther south than in others, and pass into the continent over Washington or Oregon States, and then the Chinook does not blow east of the mountains in the Canadian Territories, and north-east and north winds prevail, accompanied by continued low temperatures. In other years the storm centers just as persistently move across northern British Columbia, and then the Chinook is the rule, rather than the exception and the weather under the lee of the mountain keeps mild. As an example of the variableness of seasons, the mean temperature of January, 1886, at Edmonton was 13.4 below zero, while in 1889 it was 21.9 above, a range of 35.3. In February, 1887,, it was 10.4 below and in 1889 21.9 above, a range of 32.3. In November, 1896, it was zero, and in November, 1890, it was 38 degrees.

It wil be obvious that as the mean track of low areas is over Vancouver Island, the further we depart northward from this latitude the less frequent will be the Chinook, and hence the departures from normal values are likely to be less marked as the latitude increases, and this is found to be the case.

A feature of very pronounced importance in connection with the precipitation, i.e., rain and melted snow, of Manitoba and the larger portion of the Territories, is that in the former Province 50 per cent. and further west more than 62 per cent, of total for the year falls between May and August, and June is the month of heaviest rainfall, just the very period when moisture is required by the growing crops.

From information derived from a variety of sources, the writer has the opinion that 8 in. of well distributed rainfall between May and August in our Territories at present inhabited is sufficient for agriculture, and that further north, where the ground is more deeply and permanently frozen, less will probably suffice.

In Manitoba the rainfall is greater than in any portion of the North-West Territories. The normal annual precipitation over the Province is approximately 22 inches, and the May to August rainfall 11.5 inches; drought is therefore not much to be feared here, but westward the danger increases. From Regina westward to Medicine Hat and northward to Saskatoon there are very few rainfall records of over a few years, but there is fair evidence that the average annual precipitation over this area nowhere exceeds 15 in., and at many points is less than that amount. By reference to

the table it will be seen that the records of 18 years indicate an average rainfall of 11 inches in Saskatchewan and 12 inches in Alberta, which, with a snowfall of about 55 inches, gives a total annual precipitation of 16 or 17 inches over the larger part of Saskatchewan and 17 or 18 inches in Alberta. But it is to be remembered that the seasonal precipitation in the far West is very variable. At Calgary in 1892 the total precipitation of the year was but 7.91 inches, while last year it was 34 inches. For five years the rainfall has been ample in this region, but for many years prior to 1897 it was scant, and in several of the years irrigation appeared necessary for successful crops. We may fairly assume that there will be a return to the dry conditions, and that the Government is acting in a most judicious manner in providing for irrigation in parts of Alberta.

The writer is of the opinion that the Chinook has played an important role in producing a treeless prairie land in Southern Alberta, and Assiniboia, and that the tendency for wooded lands in Northern Alberta and northward is largely due to the diminishing frequency of the Chinook with increasing latitude. The effect of the Chinook in Southern Alberta and Assiniboia is to keep the prairies almost bare of snow during the winter and to leave it quite bare in the early spring, while further north, as the Chinook is less frequent, the snow lies deep in winter, melts and waters the ground in early spring; providing moisture for trees at a time when moisture is most beneficial. Observation appears to warrant the statement that rainfall is much more variable near the mountains than it is further east, also in southern portions of the Territories than in northern portions. In the Territories north of Edmonton, values of rain and snow have been deduced from 6 and 10 years between observations, and from these it appears probable that the normal precipitation throughout Alberta and northward into the Mackenzie River Basin is not very different except that in the higher latitudes the proportion of snow is greater.

The newly-arrived immigrant in the Canadian North-West will occasionally be frightened when a slight fall of snow and perhaps a frost occurs late in May after warm summer-like weather, but such abnormal weather, while very disagreeable, appears to do no harm to the crops. What is more to be dreaded is a light frost just before the grain is harvested in August, but nearly twenty years of observation shows that such frosts are not by any means of annual occurrence, and when they do occur they are light and local; indeed so light are they that it is not improbable that smudge fires, lighted when warning is given in the Meteorological reports, would do much towards removing all danger.

In Manitoba and the Territories now settled, October is usually a fine, bright month; the days are warm, but frosts are frequent at night and generally some light snowfalls may be expected before its close. November is winter, and as a rule in this month some of the heaviest snowfalls occur, and zero temperatures are not infrequent. To the Northward, in Athabasca, and the Mackenzie River Basin the effect of higher latitude and the shortening days is very marked, even in September, in the rapid downward trend of the temperature curve, and winter may be considered to set in before the end of October.

Table 1.—Showing the average mean highest temperature in the various months at various stations in the N. W. Territories.

Station.	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sep.	Oct.	Nov.	Dec.
Calgary	21·9	31·3	35·9	52·6	63·6	68.9	74·9	73·7	63·7	54 9	35·9	30.1
Edmonton	15·2	19·2	34·0	52·2	65·1	69·7	73·4	72·0	62·1	52 6	31·5	23·1
Medicine Hat	20·8	21·6	36·7	57·7	68·6	74 8	81·9	80·9	69·0	58·4	38·4	29·4
Prince Albert	6·6	10·2	25·3	50·1	63·8	70 6	74·7	72·9	62·1	49·5	25·7	15·1
Qu'Appelle	7·2	9·3	23 7	48·5	64·1	72·3	76·3	74 7	63·8	50·3	28·2	16·2
Winnipeg	5·4	10·4	24·6	46·	65·1	74·5	78·3	75·9	64·7	50·2	27 8	14·6
Dunvegan	0·9	16·2	28·9	48·3	63·4	70 1	74·4	69.3	60·0	41·5	25·4	9·7
Ft. Chipewyan	— 2·0	— 0·4	15·1	38·1	55 2	62·6	71·3	67·5	54·6	40·7	17·0	11·3
Ft. Simpson	—10·3	— 5·9	9·3	37·2	52·8	66·1	70·3	66·4	53·3	33 2	4·9	— 5·3
Hay River	— 9·4	— 1·3	13·6	36·6	52·5	62·9	72·4	69·6	56·9	39 2	12·1	— 0·5

Table II.—The average mean lowest temperature.

Station.	Jan.	Feb.	Mar.	Apl.	May.	June.	Jnly.	Aug.	Sept.	Oct.	Nov.	Dec
Calgary	0·0	1·8	12·4	26·7	35·7	42·4	46·5	44·9	36·8	28·1	14·9	10·8
Edmonton	— 4·5	— 1·6	11·2	28·5	38·3	44·0	47·9	46·3	37·2	29·7	13·7	5·9
Medicine Hat	— 0·4	2·8	14·1	31·0	41·4	47·8	53·3	50·9	40·7	31·6	16·3	9 4
Prince Albert	—17·0	—14·8	— 2·2	23·6	35·3	44·0	48·9	45·1	36·1	26·4	6·1	— 6.7
Qu'Appelle	—10·8	— 9·6	4·0	26·7	37·9	47·0	51·0	48·9	39.1	29·8	10·8	— 0.7
Winnipeg	—16·2	—12·6	7·9	25·3	39·0	49·7	53·8	50·5	41·0	29·3	10·0	— 5·3
Dunvegan	—24·2	—12·8	— 3·7	20·1	32·6	41·8	46·0	44·0	38·4	24·7	6·1	—14·7
Ft. Chipewyan	—18·0	—18·4	— 2·9	18·1	36·1	43·8	51·3	47·8	37·8	26·6	1·9	— 4·6
Ft. Simpson	—26·6	—26·8	—16·4	5·0	1·8	43·9	47·8	44·9	34·1	14·2	— 8·5	—19·9
Hay River	—25·9	—21·8	—13·3	13·1	30·6	39·5	49·0	46·5	37·1	23·9	— 3·0	—15·3

Table III.—The average mean monthly and annual temperature.

Station.	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Calgary	10·8	13·0	24·2	39·7	49·7	55·7	60·7	59·3	50·3	41·5	24·9	20·4	37·5
Edmonton	5·3	8·8	22·7	40·3	51·6	5 ·1	60·6	59·0	49·6	41·0	22·8	14·9	36.1
Medicine Hat	9·3	11·0	25·4	44·5	54·8	61·8	67·8	65·9	55·1	44·8	27·4	19·8	40·6
Prince Albert	— 5·5	2·8	11.3	36·8	49·1	57·6	61·9	58·8	49·1	37·6	16·0	4·2	31·2
Qu'Appelle	— 1·4	— 0·6	13·5	37·7	50·8	59·6	63·7	61·5	51·5	39·1	19·3	8·3	33·6
Winnipeg	— 5·1	1·4	12·2	36·8	52·1	62·4	66·1	63·6	53·0	39·7	19·3	5·0	33·6
Dunvegan	—11·6	1·7	12·6	34·2	48·0	56 0	60·2	56·7	49·2	34.6	15·7	— 2·5	29·2
Ft. Chipewyan	—13·2	— 9·9	4·7	26·6	43·9	55·6	61·7	58·2	46·2	32·9	—11·8	1·0	26·5
Ft. Simpson	—18·4	16·4	4·1	26·4	42·1	54·8	58·9	55·7	44·6	23·6	— 1.3	—12·5	21·1
Hay River	—17·6	—11·6	0·2	24·8	41·6	51·2	60·7	58·0	47·0	31·6	4·6	— 7·8	23·6

Table IV.—Showing the average mean monthly rainfall at various stations.

Station.	Jan.	Feb.	Mar.	Apl.	May.	June	July	Aug	Sept.	Oct.	Nov.	Dec.	Year.
Calgary	0·00	0·00	0·00	0·30	1·93	3·03	3·02	2·22	11·8	01·9	00·0	00·0	11.87
Edmonton	0·05	0·00	0·06	0·50	1·76	2·82	3·47	2·04	13·9	03·2	00·5	00·8	12.54
Medicine Hat	0·01	0·02	0·11	0·43	1·62	2·83	2·13	1·55	11·4	04·3	01·5	00·8	10.50
Prince Albert	0·00	0·02	0·10	0·40	1·35	2·68	2·21	2·11	12·7	05·6	01·1	00·0	10.81
Qu'Appelle	0·00	0·01	0·03	0·37	1·59	3·48	2·55	1·56	12·7	04·8	00·4	00·1	11.39
Winnipeg	0·00	0·00	0·25	1·17	2·15	3·53	3·08	2·63	20·9	15·2	01·7	01·4	16.78

Table V.—Showing the monthly rainfall in the year of least rainfall.

Station.	Jan.	Feb.	Mar.	Apl.	May.	June.	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Calgary (1892)	....	....	....	0·40	0·00	1·07	2·40	1·10	0·50	0·00	....	....	5·47
Edmonton (1883)	....	....	0·35	0·11	0·49	1·86	2·13	0·17	0 00	1·16	....	....	6·27
Medicine Hat (1886)	....	....	....	0·80	1 41	1·53	0·78	0 11	0 19	0 61	0·01	....	5·47
Prince Albert (1894)	....	....	....	0 26	0·44	1·48	1·42	0·72	0·69	0 04	0·12	....	5·17
Qu'Appelle (1889)	....	00·3	....	0·22	1·43	0 40	2·15	0·54	0·84	0·28	0·04	....	5·98
Winnipeg (1889)	....	....	00 4	0 65	1·79	0·45	2 38	0·95	2·67	0·84	....	....	9·77

Table VI.—Showing the average mean monthly snowfall at various stations.

Station.	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
	"	"	"	"	"				"	"	"	"	"
Calgary	4 9	6·3	7·1	3·8	2·4	....	....	....	2·1	2·7	8 2	6 4	43 9
Edmonton	6 0	7·3	6 3	3·5	1·4	....	....	....	....	4·2	5·6	6 5	39 8
Medicine Hat	6·8	7·7	6·0	2·5	0·6	....	....	....	0 5	1·4	7 6	5·2	38·4
Prince Albert	9 0	7·0	8·1	4 4	1·4	....	....	....	0·1	2·5	8·8	6·7	48·0
Qu'Appelle	5·8	8·7	8 9	8 0	2 1	....	....	....	1·1	5·5	8 2	6·0	54 3
Winnipeg	8·7	9·4	8·8	4·3	1·3	....	....	....	..	1·3	9·8	7·6	51 5

THE HESSIAN FLY

(EXTRACTS FROM BULLETIN)

—BY—

HERBERT OSBORN

Prof. of Zoology and Entomology, Iowa Agricultural College, Ames, Iowa

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ORIGINAL HABITAT OF HESSIAN FLY.

Notwithstanding all the effort that has been devoted to determining the original home of the Hessian fly, we are still in the dark as to its exact original habitat and the exact time of its introduction into America.

Two difficulties which are well-nigh insurmountable must always obstruct such precise determinations. The earlier accounts, which might be interpreted as applying to this species, are all too vague to permit one to say absolutely that they do so apply, and no distinctive name, common or technical, is available to trace the species prior to 1778.

The name "Hessian fly" was first used for the species after its appearance in New York in 1778, and presumably on the ground that its introduction was attributed to the Hessian soldiers, although, as has been suggested by Hagen, such a name might have been applied simply as a result of the bitter feeling existing against these invaders, and which sought a vent in transferring their name to the detestable pests that were ravaging the wheat fields.

The fact that it is confined so strictly to wheat, rye and barley, as food plants, should lead us to think that it has been associated with these as food plants from prehistoric times and to look for its source in the locality where these were indigenous. Inasmuch as this is a question impossible of absolute determination, although authorities generally refer their origin to western Asia, we have still a doubt; but, so far as America is concerned, we may reasonably conclude that as the hosts are introduced plants the Hessian fly is an introduced insect.

It seems unnecessary here to revive the controversy as to the introduction of this species, in view of the exhaustive papers by Professors Hagen and Riley and the evidence by the latter that all supposed references to the Hessian fly before 1776 must in reality have referred to other species. Those interested will find full details in the papers cited in the Bibliography.

DISTRIBUTION.

At present the Hessian fly has a very wide distribution throughout the wheat-growing region of Europe and America. There is evidence of its having existed probably from prehistoric time in the countries of southern Europe adjacent to the Mediterranean Sea, and, as has been stated elsewhere, great probability that it has followed its natural food plant (wheat) from the supposed original habitat of that cereal in western Asia. Its introduction into America has already been mentioned, and we need state here only those facts concerning its distribution throughout the United States that are of importance in connection with the wheat industry. Its spread in this country from about the year 1776 was for a number of years at a pretty uniform rate of progress until it occupied the wheat-growing district of the eastern United States. Following

this, its distribution quite naturally followed the expansion of the wheat district associated with the development and settlement of the Mississippi Valley. Its eastward distribution seems to have been more gradual than the westward, a recent record placing its extreme limit in Maine, at Bangor. Southward it has gone as far as the northern part of South Carolina, and in its extreme southern limit in Texas it reaches nearly to the Gulf. Westward it occurs throughout a considerable part of Kansas, the eastern part of Nebraska, and northward, according to Webster, it has been found in North Dakota, and records furnished by Dr. Howard place it at Clinton, Bigstone County, and Barrett, Grant County, Minn.

On the Pacific coast it has been recorded for the territory adjacent to San Francisco by Koebele (55), and Professor Woodworth (141) discusses its occurrence and variations in the wheat fields of the experiment station at Berkeley. An article by Mr. A. Gains (41), entitled "Potato bug and Hessian fly," in the Oregon Naturalist for January, 1896, would indicate that it has appeared in Oregon, but the article is not at hand for a determination of the locality.

Professor Piper of the Washington Agricultural College states that the Hessian fly is as yet unknown in Washington, although they are in fear of its introduction. Professor Aldrich, of the University of Idaho, says that it has not appeared in that State.

From this distribution it may be concluded that the Hessian fly has practically the same distribution as its food plants except for the northern limit, where conditions seem to interfere with the successful existence of the insect.

In Germany the Hessian fly has attracted frequent attention, but it appears to be confined more to the southern provinces and to be less noticed, or at least not often destructive in the north. Lindemann (60) credits it to Silesia, Posen, Pomerania, Bavaria and Wurtemburg.

In Austria-Hungary it is credited to Hungary, Carinthia, Istria, Moravia, Bohemia, "Sachsen Coburg."

In Italy it has been located at Brindisi and Naples.

In Russia Lindemann states that it has a very wide distribution. Through his own researches and through numerous correspondents who furnished him material he located it in thirty-six different provinces, as follows: Bessarabia, Vladimir, Vologda, Volhynia, Kursk, Mohilev, Moscow, Nischni Novgorod, Samara, Saratov, Simbursk, Smolensk, Voronesh, territory of Don Cossacks, Eketerinoslav, Kazan, Kaluga, Kiev, Kostroma, territory of Kuban Cossacks, Novgorod, Orel, Penza, Podolia, Poltava, Pskov, Perm, Riazan, Stavropol, Tambov, Toula, Kharkov, Kherson, Tschernigov, Estland, Yaroslav.

In Norway Schoyen reports it as occurring at Hole, Ringerike and points near Christiania.

In England the Hessian fly first appeared in 1886 in Herefordshire, Essex, and at other points.

In France the Hessian fly has been particularly destructive in Vendee, as recorded by Marchal (71), and it has also been credited to the province of Isere. Dana recorded its occurrence at Toulon.

So far there seems to be no record for Belgium, Holland, Denmark, or Sweden, although there would be good reason to suppose its possible occurrence in these countries, as also in Spain (recorded by Dana in the Island of Minorca) and in Portugal, where no observations seem to have been made. In quite recent years it has been introduced into New Zealand, as recorded in the following note from Insect Life (Vol. 1, p. 32):

The Hessian fly halfway round the world.—The Hessian fly, Cecidomyia destructor, has reached New Zealand. The March 1888 number of the New Zealand Farmer reports it from four different farms in the Rangitikei district, one of these being at Bellevue, near Marton, a town 33 miles southeast of Wanganui, in the State of Wellington.

MEANS OF DISTRIBUTION.

The powers of flight possessed by the Hessian fly are sufficient to provide for its ready dispersal over limited areas, and where there are continuous or slightly separated plantings of wheat, rye or barley no other means of dispersal need be sought.

This natural spread was estimated by

Fitch to be at the rate of about 20 miles per year in the vicinity of eastern New York, based on its extension from the centre on Long Island, where it was first observed and from which it spread in all directions. This rate would seem to be as high as is admissible from purely natural means, as with plants at hand for deposition of eggs there is little tendency on the part of the insect to leave the field where it emerges, especially for the autumn brood. In the local transfer of straw, however, there is opportunity for some further dispersal which might supplement the flight of the insect in slight degree.

The only other means of distribution, and the only one which seems a possible basis for its transportation to distant regions, is by the carriage of straw containing the puparia, or "flax seeds," as they are called. Under ordinary conditions it is evident that this straw must be transported during the summer (resting period of the insect) and that puparia retaining their vitality must, in the new location, be brought into proper situations to permit the development of pupae and the emergence of adults. The winter "flax-seeds," being contained within the sheaths of growing plants and below the surface of the ground, could not furnish a means of dispersal, as at that time the only means of distribution would be the shipment of growing plants and their transplanting in a new locality, a process certainly not to be thought of as a probable source of dispersal. With ordinary development of the summer "flax-seeds" there would appear to be little chance of scattering the insect in straw, especially since the great majority of these must be in the stubble remaining in the field where they grew. It has been proved, however, that the puparia may retain their vitality under certain conditions for long periods of time, and certanly those whch may be high enough to be taken from the field with the straw would find most favorable conditions for the retardation of their development so that they might be ready for the completion of their cycle when the straw is scattered on moist ground in some other and possibly far-distant locality. The carriage, then, of puparia in straw used for packing and shipped from point to point would seem to be the only means available for the wide dispersion of the insect, and it is to this method that its dispersal is generally credited. The introduction into the United States near New York City has as its most probable foundation, the straw used as bedding by the Hessian troops landed during 1776 and 1777, and while there is lacking positive evidence that the insect existed at the point of their starting or even of embarkation, the source of straw they might have used and scattered after landing may have been in some infested locality, while the argument that the troops arrived at a time of year when the insect could not have been transported disappears when we recognize the possibilities of retardation elsewhere discussed.

The recent introduction of the insect into New Zealand is believed to have been due to the scattering of straw used in the packing of merchandise, and while the exact time seems unknown, the certainty that the introduction must have been in some such manner shows how important is the destruction of such packing material in any country where the insect is not present and where grain growing is of any consequence. Careful attention to this point may serve to postpone, at least for some time, the dispersal of the insect in the wheat-growing sections of Oregon, Idaho, Washington and other points, especially where wheat culture is carried on in isolated districts separated from other wheat regions by extended ranges of mountains or stretches of arid land.

DESCRIPTION AND LIFE HISTORY.

The descriptions of the Hessian fly have been quite numerous, and some of them given with considerable accuracy of detail, so that there should be little difficulty in distinguishing the species from related forms. In many cases it is, however, deficient in characters which definitely separate it from the most closely related forms. It is clearly of no little importance to have a positive basis for the separation of the insect from related forms, particularly those which occur in closely related plants, and especially if they agree with it in the character of the puparia.

The adult insect, like other

members of the family Cecidomyidae, to which it belongs, is a small, gnat-like, two-winged creature, about half as large as a common mosquito, which it resembles in form.

The female is about one-tenth of an inch long (2.5 mm.), of a dark color, the abdomen in freshly issued specimens appearing red, with black patches or bands of black, and with red bands at the articulations, depending upon the amount of distension.

The head is small, somewhat contracted dorsally, with a row of bristles on the posterior margin; eyes black, antennae long, black, semi-pallid, usually of 17 joints, this number varying in different specimens from 16 to 18; joints rather short, cylindrical, and joined by a very short, small filament, each provided with an irregular whorl of fine hairs. The thorax has two rows of long backwardly curving bristles near the median line, and a patch on either side. The legs are long and delicate, with a dense covering of blackish scales dorsally, the basal joint of the tarsus very short. The wings appear smoky black from scaly covering, but the scales are very narrow, not broad, as those on the body and legs. The halteres are yellowish, with broad blackish scales covering the outer part, the basal part naked, except a narrow border.

The abdomen is long, ovate when contracted, but capable of great extension for the terminal segments. The ovipositor is compressed, cyclindric, very minutely hairy, with an oval lobe at the extremity, which is minutely striate and more densely hairy than the basal portion.

The male is smaller, more slender, and appears darker than the female. The antennae are longer, the joints more distinct, 17 to 19 in number or 16 to 20 for extremes, and connected by a much longer filament and the whorl of hairs is much more prominent, the hairs longer, and arranged in a more perfect vertical. The outer claspers are very robust and apparently loosely connected to the abdomen. The basal part is heavy, with numerous strong tubercles and a few scattered bristles. The distal part is, when at rest, at nearly right angles with the basal part, narrower, faintly tuberculate, very minutely hairy, and with a strong claw-like tooth at end. The inner claspers are broad, oval, minutely hairy, the posterior margin with a row of fine hairs, and toward the apex three or four blunt teeth. Between the claspers is a strong chitinous process, and anterior and dorsal to them two pairs of finely haired, slender, finger-like processes directed dorsally; anterior to these, and forming the posterior border of the abdominal segment, is a prominent hairy rim, broken at the median line dorsally.

The egg is characterized as about one-half millimeter long, cylindric, roundingly pointed at the ends, glossy translucent, slightly reddish in color, and becoming deeper red with development.

The larva has usually been described without reference to distinct stages, but Marchal (71) has defined three forms, the first of which, just issued from the egg, is capable of locomotion and travels from the point of hatching to the location under the sheath. Its size is slightly larger than the egg from which it hatches, and it presents thirteen segments, of which the first constitutes the head. It is distinguished from the second form principally by the presence of two triangular, fleshy, ear-like appendages, lightly incurved below on each side, and comparable to tentacles; the anterior buccal border is trilobed, and beneath is the mouth in the form of a small triangular opening. The last segment is lightly emarginate posteriorly, and each of the two lobes thus formed carries four setiform papillae.

The second larval form, which is fixed to the stalk and is the one usually described by writers, is, when grown, 3 millimeters long by a little less than 1 millimeter wide, of a flattened, cylindrical form, and so transparent that the internal organs are easily seen. There are twelve segments beside the head, which is small and more or less retracted. The anterior end is narrowed and usually somewhat bent. The posterior end tapers, is bluntly rounded, and with two lobes on the posterior segment. The segments are but slightly indicated externally, but are plainly marked by the internal masses of adipose tissue arranged in series along each side, as well as the respiratory organs, the spiracles being plainly visible under the microscope as minute openings in rounded yellowish

tubercles. The mouthparts are indistinct, and the sternal spatule is, until the larva is ready to pass to the next form, either entirely wanting or inconspicuous. The digestive, nervous, tracheary and adipose systems, which are very plainly visible in the larvae, have been described in particular by Marchal, whose paper should be studied for details in this regard.

The third larval form—that inclosed within the puparium—is distinguished especially by the development of the sternal spatule or "breastbone." In other respects there is little difference anatomically from the preceding, but it is a quiescent not a feeding stage. The sternal spatule, which becomes conspicuous at this stage, is a horny structure projecting from between the first and second body segments, and is provided at its anterior extremity with two pointed spurs. The bifurcate form of this spatule is used by Marchal (71) to separate this species from avenae, in which there is but one point. The use of this organ, which projects forward under the first segment and rests against its ventral surface, has been a subject of considerable discussion. The explanation which is best supported was proposed by Enock and is sustained by Marchal (71). This is that the spatule is used by the larva to reverse its position in the puparium so that, whereas the larva rests at first with its head downward and toward the roots of the plant, it rests, after turning, with its head upward and toward the upper part of the plant, a position which has obvious advantages when we consider the direction in which the pupa and imago must escape.

The pupa when first issued from the puparium is white, but acquires a rosy tint. It presents a very delicate appearance, the pupal case being extremely thin. On the front is a prominent pointed chitinous rostrum of a brown color, the function of which is considered to be the cutting of the puparium to permit the exclusion of the pupa. Above the origin of the antennae are two horns called by Marchal the cephalic horns and posterior to them two larger, curved, thoracic horns which contain, according to Marchal, trunks of the tracheary system.

EFFECT UPON THE PLANTS.

The attacks of the Hessian fly upon the plants produce very characteristic effects, generally so distinctive that the appearance of a field will at once indicate to a practiced eye the presence of the pest. The effects differ with the season, perhaps, more properly, with the stage of growth of the wheat plant at the time of attack.

In autumn the eggs are laid upon the early appearing leaves and the passage of the larvae down the sheath carries them down to or below the surface of the ground, often very near to the root itself. Here their presence causes more or less swelling of the base of leaf and culm, scarcely enough to be counted a gall formation, but the immediate effect seems to be a stimulus at the point of attack. Indeed, as Webster has pointed out, the affected plants present a darker green color, which has been recognized by farmers as indicative of Hessian fly attack, this color to be followed later by a brownish and then a yellowish color for the infested tillers. If the plant is attacked early and fails to tiller, the result is death of the whole plant; if tillers have already formed, the larvae may enter but one or part of them, and the others may develop into healthy stalks and furnish the basis for a crop.

The attack in spring being made usually after the stalks are well formed, the eggs are placed on the lower leaves, and the larvae, as a rule, will be found just above the first joint. Their presence here so weakens the stalk that it bends over, the upper part of the stalk falling to a horizontal position and at right angles to the base. The appearance of these fallen stalks is particularly characteristic, and an examination will bring to view the larvae or puparia just below the bend and above the lower joint. Rarely the larvae may occur above the second or third joint, and it is stated that sometimes they pass below the ground, as with the autumn brood, and in such case the stalk falls by breaking at the surface of the ground. These facts have a value not only as a means of distinguishing the Hessian fly from other wheat pests, but it can easily be seen that the position of the larvae must be a determining factor in the adoption of certain measures of control.

NATURAL ENEMIES OF THE HESSIAN FLY.

The importance of the parasite of the Hessian Fly is probably hard to overestimate, since to this factor we have doubtless to refer the usual scarcity of the insect. This may be inferred, in part, from the fact that Say in, in his original description of the Cecidomyia, presented a description of one of the most abundant of the parasites which was already at that time recognized as an efficient agent in the destruction of the pest.

It is also shown by the estimate commonly made by the writers who have dealt with the subject that fully nine-tenths of the Hessian flies are destroyed by parasites, a circumstance which accounts for the fact that the Hessian fly is seldom abundant or excessively destructive for more than one year at a time in any particular locality. In the specimens which were received from different points in Iowa in 1896 I was unable, because of the parasites, to secure a single perfect fly, and I am informed by Dr. Lugger, the State entomologist of Minnesota, that his experience for 1897 was the same as reported in his annual report for 1896.

OTHER NATURAL ENEMIES.

Nematode worms.—Marchal has called attention to the occurrence of nematodes in the infested straws and even in the puparia of the Hessian fly, but never in the larvae themselves, although the appearance of the latter would indicate destruction by the worm. Whether this is a normal parasite of the Hessian fly may be questioned, but that the worms might easily destroy such larvae as they came in contact with would seem very possible.

Thrips.—Both Mr. B. D. Walsh and Mr. Theo. Pergande have expressed the opinion that the Cecidomyia may be attacked by thrips, but, so far as I am aware, no demonstration of such attack has been made. Their remarks on this subject have been republished in volume I. of Insect Life, pages 138 and 139.

REMEDIES.

While investigations of recent years can hardly be said to have added any absolutely new methods of treatment, it is evident that more precise knowledge of the life history and especially of the variations in time of appearance and number of broods does enable us to state with much greater confidence the conditions under which certain measures are available. Knowing the conditions affecting acceleration and retardation of development. It becomes possible to specify the appropriate occasion on which to resort to burning, plowing under, delay of seeding, etc., and it will be our effort in the following discussion of remedies, most of them of long recognition, to so state the conditions under which each may be most effective that the cultivator himself, without having to call in a professional entomologist to examine the field, may act intelligently.

In fact, we have the authority of Professor Webster for the statement that the Hessian fly need be no longer a source of loss under a proper system of agriculture. That the farmer, however, be best prepared to contend with the insect involves for him a thorough knowledge of the conditions favoring or obstructing the action of the insect, and to this end he should be particularly familiar with the conditions of acceleration or retardation of development as affecting the time of appearance of the various broods.

Probably the most important measures available with our present knowledge are those directed against the insect in its summer resting period or the early issuing flies of late summer and early autumn.

BURNING THE STUBBLE

This remedy has been one of the standard measures from very early times, and while objection has been raised to it on account of the fact that the parasites will be destroyed along with the Hessian fly, it may be considered as one of the most generally applicable. To be effective, the burning must be performed before the flies have had an opportunity to emerge, but in this respect there is little danger of being too tardy unless unusual moisture accelerates the emergence of the flies. Postponement until the parasites have had an opportunity to emerge would, in fact, be an advantage, and, during dry weather in July and August, the firing may be

postponed. In some cases the burning is made more effective by cutting the wheat pretty high, so as to leave a larger amount of stubble, thus insuring a more rapid spread of the fire. It has the further advantage of leaving with the stubble any chance "flaxseeds" which may occur higher up on the stalk than the usual position.

An objection to burning, which has been suggested by Lindemann, and is supported by Marchal, is that under a given climate it may be that at the time of harvest a considerable part of the puparia will have already matured and the flies issued, so that those destroyed will be simply an insignificant part that have been delayed in their development, and their destruction, while useful, would be so in but a slight degree. The determination of the condition of the "flaxseeds" would be difficult except by examination by an expert entomologist, and treatment with reference to this point is rather impracticable. So far as the American wheat grower is concerned, it would seem unwise to use this objection, as the benefit in general from burning infested stubble is so great that other considerations may be overlooked. The main point is to determine the time of movement, and this in general should be as soon after harvest as the conditions of the season are likely to cause the emergence of flies.

Along with the burning of the stubble we may call attention to the desirability of burning chaff and screenings after threshing, as Miss Ormerod has pointed out that many puparia are to be found in these materials. While probably less useful in this country where the straw is of less value and is not cut so close to the ground, the fact that we have here a possible source of danger is sufficient reason to take the small trouble necessary to guard against it.

THE PLOWING UNDER OF STUBBLE.

Next to burning, and available when burning is impracticable, the plowing under of stubble is perhaps most important. To be most effective the stubble should be turned to the depth of several inches and the field rolled, so as to compact the earth and prevent the issuing of the flies which may develop from the puparia in the ground. The time of plowing depends upon the condition of the season, and here the conditions which suggest plowing in ordinary farm practice are those which best apply to the destruction of the insect. If the season be dry, the necessity for plowing does not exist, as the great majority of the insects will remain in the dormant condition, and those which hatch will fail to find food plants upon which to deposit eggs upon which the larvae can feed. With the occurrence of rains, which put the ground in suitable condition for plowing, there is probability of an early emergence of flies, and, further, of the springing up of volunteer wheat to furish their progency with necessary food.

In this connection it may be mentioned that where the crop is so seriously infested that it is not considered worth harvesting, it may pay to plow it under as early as possible, roll thoroughly, and plant to corn or other late crops. This method was adopted with excellent results by some farmers in the spring-wheat region of northern Iowa.

DESTRUCTION OF VOLUNTEER WHEAT.

It is evident that if all the food supply for insects during late summer and early autumn is destroyed, the flies emerging during this period will be unable to deposit eggs or their larvae to develop. The volunteer wheat around stacks or through the fields, if present in any quantity, should be plowed under, so that this source of food supply may be cut off.

PLANTING OF DECOY STRIPS.

Many authors recommend the planting of narrow strips of wheat in the field as decoys, but the plan has apparently been little used by farmers. This is perhaps because it entails extra labor and expense and presents only possible advantages. Professor Webster considers that while it is hardly possible to entrap the major part of the fall brood of larvae, it is certainly possible to entice to these plats the stragglers and interlopers, which have been known to be capable of considerable injury. While the pest can not be exterminated in this way, its power to commit serious injury may be considerably weakened. Volunteer wheat would apparently serve

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the same purpose if appearing early enough to attract the flies, and should in any case be plowed under as deeply as practicable. The proper time for sowing decoys will vary with the latitude. According to Webster, for northern Indiana, they should be sown during the latter part of August, and in the southern part of the State not later than the first week in September. To the north and south of this he does not undertake to give dates, but it would depend upon the date of appearance of the fall brood of flies, the wheat being planted early enough to attract the flies at the time of their emergence. A decoy crop should be destroyed within four weeks at the utmost, and turned under so deeply that any insects maturing would be unable to escape.

EARLY OR LATE SOWING OF FALL WHEAT.

In winter-wheat regions the time of sowing in autumn is, with reference to the Hessian fly, a very important item. Early-sown wheat will naturally be exposed to the deposition of eggs by flies issuing in the autumn, but, on the other hand, if the plants have got well started and thrown out numerous tillers there is much less danger of their complete destruction, and if the flies should not be numerous a considerable gain may result. The principal objection to this view would seem to be that the multiplication of the insect is encouraged and there would be a strong probability of more serious attack the following spring. Early sowing may be practiced if desired, especially on a small scale, and then if it is found that the crop is considerably infested it may be plowed under the same as a decoy crop and the field resown later.

Late sowing of fall wheat has been one of the principal resources against the Hessian fly, and the writings of most of the leading entomologists have agreed in a strong recommendation of this policy. Packard quotes numerous writers in support of this general plan, and it appears to be very generally adopted by farmers. To be successful the sowing should be late enough so that the plants do not appear above ground until after the bulk of the Hessian flies have issued and died. It has been shown, however, that the flies may emerge quite late in the season and deposit eggs even after frosts are common. Marchal remarks that in Vendee the wheat sown after October 20 has been completely free from injury. In the practical use of this remedy it becomes essential for the farmers of any given latitude to determine the time of appearance for the bulk of the autumn brood of flies and to time the late sowing accordingly. This will be a progressive date from north to south. Webster says:

If farmers in the extreme northern part of Indiana and in southern Michigan can sow their wheat with safety about the 12th to 15th of September (and we have demonstrated that the fall brood emerges largely prior to the 15th) and farmers in the extreme southern part of Indiana delay sowing until after the first days of October, there must be a general system of retardation which, if understood, may be used to advantage throughout the intervening territory.

Starting in southern Michigan on the 12th or 15th of September and passing 4 degrees south to the vicinity of Evansville, Ind., we should expect about the same condition of the Hessian fly during the first week of October; that is, if we pass the danger line about the second week of September in southern Michigan, we should expect to encounter it again in southern Indiana in the first or second week of October. A considerable correspondence and my own experiments indicate that this is easily true.

Evidently there will be considerable seasonal variation, so that these dates must be taken subject to slight changes in either direction, but it may be assumed that the earlier or later appearance of the brood will depend upon the character of the season in moisture and warmth, so that if the weather remains unusually dry and hot the fall planting should be proportionately delayed, while if conditions favor an early emergence a crop may be planted somewhat earlier. Taking the latitudes mentioned as a guide, the farmers of the winter-wheat belt through Illinois, Missouri, southern Iowa, Nebraska, and Kansas can determine pretty accurately as to the proper time for seeding.

INTERMITTENT WHEAT CULTURE.

While the Hessian fly is a winged insect and capable of travelling to some distance, the fact appears that it prefers to deposit its eggs in the immediate vicinity of the place of its emergence. This is considered especially true of the adults from the spring brood, which are supposed to select the tillers in the field where they emerge rather than to scatter to adjacent fields. The interruption of wheat culture, therefore, for one or two seasons, even if adopted on a single farm, will have an appreciable effect in preventing injury to the crop in after years. A suitable rotation, even as applied to a single field, is counted as serviceable in the reduction of Hessian fly injury. If communities can adopt a uniform system of rotation or alternation of wheat crops with crops that are not capable of supporting the Hessian fly they should secure almost perfect immunity from this pest. In fact, this seems to me to be practicably accomplished throughout a large part of the State of Iowa, where wheat is grown as an occasional crop and the Hessian fly has been practically unknown since the early settlement of the State.

PASTURING WITH SHEEP.

One of the methods suggested in the early history of the Hessian fly problem was that of pasturing the winter wheat for the purpose of destroying the larvae. The first published account of the insect states that by feeding the crop very close in winter and spring, if the land is rich it will again spring up and the worms do not much injure the second growth. If practiced at the right time it is possible that the eggs might be nipped off and devoured with the leaves, but if it is remembered that the eggs usually hatch within four days after deposition that the plants at this time would furnish rather limited pasturage, and that the larvae soon after hatching make their way down to the surface of the ground or below it. it will be seen that there is little basis for favorable results in this method. If the flies are noted as depositing freely at a particular time, and sheep or other stock are turned in at once in sufficient numbers to graze the crop pretty closely, a considerable reduction of larvae might result. The method, however, involves pretty close observation on the part of the farmer to determine the fact of deposition.

ROLLING.

The suggestion that the passing of a heavy roller over the ground will serve to crush the eggs has been commented on by Fitch. He suggests that it may be successful, particularly on fields that are so smooth and free from stones that almost every plant will receive a firm pressure by the operation. Necessarily the method must be applied immediately after deposition of eggs, and Fitch suggests that some plan of brushing the leaves would be still more effective by dislodging the eggs and preventing the larvae from following their usual course into the sheath of the young plant.

MOWING.

Of this method Fitch says:

Mr. Goodhue, of Lancaster, Wis., in a communication in the fifth volume of the Prairie Farmer, suggests that the larvae concealed within the base of the leaves may be destroyed by mowing the wheat and feeding it to the stock. We deem this proposal a valuable one for exterminating the second or spring brood from a wheat field. In those cases where the worms are discovered in the month of May to be fearfully numerous at the joints of the young stalks, there can be little doubt but that on smooth ground the scythe may be so used as to take off almost every spear befow where the larvae lodged; and that thus a second growth of stalks will be produced, quite free from these depredators. The following facts lead me to believe that on a fertile soil wheat may be thus mowed with little if any eventual injury to the crop. Portions of a field of my own, the past season, grew so rank that, deeming that it would become lodged and mildewed, by way of experiment a space in it was mowed down after the plants were two feet in height, and another after the heads had begun to put forth. Though not so early in ripening, the appearance of these two patches at harvest proved, so far as a single experiment could do, that wheat might be mowed at the former period without any diminution of its productiveness, while at the latter both the straw and heads would be of a more slender and feeble growth.

There would seem to be few occasions where this method could be used, and I am confident that in the majority of the western States it would be entirely impracticable, as the presence of the fly is not manifest early enough in the season to permit of its adoption.

SELECTION OF RESISTANT VARIETIES OF WHEAT.

From early times there has been a recognition of the fact that certain varieties of wheat were much less subject to injury than others. Considerable literature has accumulated concerning these "flyproof" varieties. The varieties possessing these qualities are such as have coarse and siliceous stems, enabling them to stand and not break over from the presence of the fly. Varieties which tend to develop secondary shoots or "tillers" are also considered preferable during seasons when the Hessian fly is prevalent. Of such varieties a considerable list has accumulated, many of which are doubtless obsolete at the present time. The Underhill variety is stated to have been the favorite for nearly a century. The Mediterranean wheat has been held in high repute in the Middle States, as also the Red Cap and Red May. The Clawson receives strong commendation from various sources,and Professor Cook speaks of it as a favorite variety in Michigan. The Spelter, China, and White Flint are mentioned by Fitch,but do not seem to have remained in favor.

Prof. C. W. Woodworth improved the opportunity of the occurrence of the Hessian fly in the experimental plats of the University of California to note the effects upon different varieties, and made a list, including something like a hundred and twenty different varieties.

He tabulates his result for the three years, 1886, 1887 and 1889, and summarizes his conclusions as follows:

Volo and Washington Glass are the only varieties that have remained free from the Hessian fly. The latter, however, never yields well with us. Several other varieties have a very good record. Especially free from the fly are the following: Bearded Wheat from Missoyen, Forelle, Palestine. Polish, Blue Grass, Common March, Diamond, Egyptian Imported.

The following varieties have had more or less fly, but never in abundance: Bearded Macaroni, Big Long-bearded Club, Egyptian, Genoese Winter, Greek Atlanti, Hunter's White, Imported Circassian, Nicaragua, Nonette, Lausanne, Red Club, Russian Red bearded, White Club.

He further makes a comparison of early and late varieties, and of 100 early varieties only 45 were badly infested, against 67 of the late, an advantage for the early varieties of over 20 per cent.

This question seems not to have received as much attention in Europe as in America, but Miss Ormerod has named the Square Head, the White-chaff Red, Golden Drop, and Rivett's Red as resistant varieties, while in France Marchal cites M. de Biguet, Professor of Agriculture, as recommending the Bordeaux wheat as a resistant variety.

USE OF INSECTICIDES.

There seems to be scarcely any reason to expect success from the use of direct remedies in the form of insecticides, but some efforts have been made in this direction, and attempts to destroy the larvae with lime, soot, salt, etc., have been made. None of these, however, seems to us to have sufficient merit to deserve extended notice. Aside from the expense and labor of their employment, there is little reason to believe that they will accomplish as much as the more simple methods of farm practice. The same may be said with still greater emphasis concerning all suggestions as to treatment of the seed wheat, since there is no possible connection between the seed wheat and the infestation of the field.

COMBINATION OF REMEDIAL MEASURES.

A little thought concerning the measures which have been discussed above, with a recognition of the life-history facts upon which they are based, will suggest that the best practical results will be obtained not by reliance upon any one method, but by an intelligent adaptation of two or more, according to the conditions prevailing for the season. These will constitute a practice which can be modified for each year, as the conditions will indicate.

With the harvesting of the grain,there

is open the policy of burning the stubble or plowing it under or allowing it to stand for the exclusion of parasites. If the weather is very dry, it will be best to defer burning, to allow the issuance of as many parasites as possible, but if burning is to be adopted at all, it should be done before fall rains set in or the field has grown up to weeds. If rains occur early, burning will be best; and in any case the stubble should be plowed under and rolled as soon as there is any appearance of a volunteer growth of wheat. The chaff from threshing should be burned and the screenings burned or fed to stock as early as possible, and care should be taken during autumn to plow under and roll the volunteer wheat that springs up in the stackyard. If winter wheat is to be planted, strips of decoy wheat may be put in to be plowed under at the end of three or four weeks, and finally the crop planted at as late a date as practicable, according to dates given in the paragraph on late planting. This practice can be duly combined with the selection of resisting varieties of wheat and the application of fertilizers.

It will be observed that the modifications are based primarily on the weather —whether dry or moist, a condition apparent to everyone, and that the suggestion amounts to postponement of burning or plowing if dry, or the early adoption of one or both if wet.

Be Prepared, Don't Depend on Talk

USE

SPOONER'S POWDERED **"PHENYLE"**

Germ Killer and Disinfectant

Commended by Prof. Ellis' Analytical Certificate. To be used by Public Schools and Buildings, and Boards of Health, to prevent Epidemics and Contagious Diseases.

STRONGEST DISINFECTANT AND QUICKEST DEODORIZER ON EARTH

INEXPENSIVE

Put up in Tight Pails and Barrels, and will always hold its Strength.

MANUFACTURED BY

ALONZO W. SPOONER

PORT HOPE, ONT.

Increase of Canadian Trade

The following is a statement showing the grand aggregate trade from 1868 to 1902, inclusive, on the basis of "Total Exports and Imports:"

Years.	Total Exports.	Total Imports.	Grand Total Imports and Exports.
	$	$	$
1868	57,567,888	73,459,644	131,027,532
1869	60,474,781	70,415,165	130,889,946
1870	73,573,490	74,814,339	148,387,829
1871	74,173,618	96,092,971	170,266,589
1872	82,639,663	111,430,527	194,070,190
1873	89,789,922	128,011,281	217,801,203
1874	89,351,928	128,213,582	217,565,510
1875	77,886,979	123,070,283	200,957,262
1876	80,966,435	93,210,346	174,176,781
1877	75,875,393	99,327,962	175,203,355
1878	79,323,667	93,081,787	172,405,454
1879	71,491,255	81,964,427	153,455.682
1880	87,911,458	86,489,747	174,401,205
1881	98,290,823	105,330,840	203,621,663
1882	102,137,203	119,419,500	221,556,703
1883	98,085,804	132,254,022	230,339,826
1884	91,406,496	116,397,043	207,803,539
1885	89,238,361	108,941,486	198,179,847
1886	85,251,314	104,424,561	189,675,875
1887	89,515,811	112,892,236	202,408,047
1888	90,203,000	110,894,630	201,097,630
1889	89,189,167	115,224,931	204,414,098
1890	96,749,149	121,858,241	218,607,390
1891	98,417,296	119,967,638	218,384,934
1892	113,963,375	127,406,068	241,369,443
1893	118,564,352	129,074,268	247,638,620
1894	117,524,949	123,474,940	240,999,889
1895	113,638,803	110,781,682	224,420,485
1896	121,013,852	118,011,508	239,025,360
1897	137,950,253	119,218,609	257,168,862
1898	164,152,683	140,323,053	304,475,736
1899	158,896,905	162,764,308	321,661,231
1900	191,894,723	189,622,513	381,517,236
1901	196,487,632	190,415,525	386,903,157
1902	211,640,286	212,270,158	423,910,444
1903	225,849,724	241,214,961	467,064,685

THE DOMINION

The following tabulated statement of the public

Year.	Expenditure chargeable to Consolidated Fund	Expenditure chargeable to Capital.	Railway Subsides.	Other Charges.	Total Disbursements
	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.
1868..	13,486,092 96	548,437 58	.....	37,157 98	14,071,688 52
1869..	14,038,084 09	440,418 40	.....	429,663 24	14,908,165 64
1870..	14,345,509 58	3,515,116 18	.....	155,988 18	18,016,613 94
1871+	15,624,081 72	3,670,396 51	.....	.....	19,293,478 23
1872..	17,589,468 82	7,853,049 76	.....	223,456 13	25,665,974 74
1873..	19,174,647 92	19,859,441 17	.....	5,718 68	39,039,807 57
1874..	23,316,316 75	10,177,740 06	.....	4,018 90	33,498,075 71
1875..	23,713,071 04	6,922,742 33	.....	2,253,097 17	32,888,910 54
1876..	24,488,372 11	7,154,007 94	.....	315,764 40	31,958,144 45
1877..	23,519,301 77	7,599,706 55	.....	1,388,984 38	32,507,995 70
1878..	23,503,158 25	6,657,200 36	.....	385,412 99	30,545,771 60
1879..	24,455,381 56	5,648,331 66	.....	676,225 30	30,779,938 52
1880..	24,850,634 45	8,241,173 98	.....	949,947 68	34,041,756 11
1881..	25,502,554 43	3,176,316 50	.....	117,771 74	33,796,642 66
1882..	27,067,103 58	7,405,637 06	.....	201,884 75	34,674,625 39
1883..	28,730,157 45	14,147,359 76	.....	21,368 75	42,898,885 96
1884..	31,107,706 25	23,977,702 54	208,000 00	2,567,451 84	57,860,861 53
1885..	35,037,060 12	13,220,185 35	403,245 00	502,587 06	49,163,077 53
1886..	39,011,612 26	9,589,734 19	2,701,249 00	10,534,973 07	61,837,568 52
1887..	35,657,680 16	4,439,938 72	1,406,533 00	.....	41,504,151 88
1888..	36,718,494 79	7,162,964 26	1,027,041 92	155,623 07	45,064,124 04
1889..	36,917,834 76	4,420,313 66	846,721 83	1,333,327 81	43,518,198 06
1890..	35,994,031 47	4,053,158 98	1,678,195 72	44,946 56	41,770,332 73
1891..	36,343,567 96	3,115,860 04	1,265,705 87	68,074 32	40,793,208 19
1892..	36,765,894 18	2,164,456 78	1,248,215 93	2,094,569 43	42,272,136 32
1893..	36,814,052 90	3,088,317 60	811,394 07	139,963 34	40,853,727 91
1894..	37,585,025 52	3,862,969 67	1,229,885 10	330,353 60	43,008,233 89
1895..	38,132,005 05	3,030,490 40	1,310,549 10	299,293 89	42,872,338 44
1896..	36,949,142 03	3,781,311 2	3,228,745 49	137,185 19	44,096,383 92
1897..	38,349,759 84	3,523,160 23	416,955 30	682,800 52	42,972,755 89
1898..	38,832,525 70	4,143,503 39	1,414,934 78	943,317 19	45,334,281 06
1899..	41,903,500 54	5,936 342 94	3,201,220 05	501,571 76	51,542,635 29
1900..	42,975,279 51	7,468,843 24	725,720 35	1,319,125 48	*54,035,119 63
1901..	46,866,367 84	7,695,488 34	2,512,328 80	908,681 42	57,982,866 46
1902..	50,759,391 97	10,078,638 06	2,093,939 00	1,038,830 83	63,970,798 86
1903+	51,691,902 76	7,052,724 58	1,463,222 34	1,538,722 13	61,746,571 81
	1,127,815.771 99	249,823,182 91	29,193,802 71	32,635,437 84	1,439,468,195 45

*Including the sum of $1,547,623.74, expenditure South African Contingent

FINANCES

accounts is compiled from the official returns :

Consolidated Fund Receipts.	Other Receipts.	Total Receipts.	Difference between Receipts and Expenditure.	Sinking Fuuds.	Net Difference between Receipts and Expenditure.
$ cts.	$ cts.	$ cts.	$ cts.	$ cts.	$ cts.
13,687,928 49	.....	13,987,928 49	383,760 03	355,266 66	28,493 37
14,379,174 52	.....	14,379,174 52	528,991 12	426,806 66	103,184 46
15,512,225 65	27,431 71	15,539,657 36	2,376,956 58	126,533 33	2,350,423 25
19,335,560 81	39,475 98	19,375,036 79	+ 81,558 56	421,666 23	+ 503,224 80
20,714,813 68	.....	20,714,813 68	4,951,161 06	470,606 67	4,480,554 39
0,813,469 45	157,121 90	20,970,591 35	18,069,216 22	407,826 62	17,661,389 60
24,205,092 54	303,560 39	24,507,652 93	8,990,422 78	513,920 00	8,476,502 78
24,648,715 05	1,008 58	24,649,723 62	8,239 186 92	555,773 32	7,683,413 60
22,587,587 05	4,468 22	22,592,055 27	9,366,089 18	822,953 32	8,543,135 86
22,059,274 11	868,486 44	22,927,760 55	9,580,235 15	896,440 00	8,683,795 15
22,375,011 88	31,245 49	22,406,257 37	8,139,514 23	1,012,753 35	7,126,760 88
21,517,382 14	4,503,142 76	27,020,524 90	3,759,413 62	1,131,296 17	2,628,117 45
3,307,406 69	57,140 21	23,364,546 90	10,677,209 21	1,215,807 96	9,461,401 25
29,635,297 54	.....	29,635,297 54	4,161,345 12	1,217,153 33	2,944,191 79
33,383,455 52	1,799,093 69	35,182,549 21	+ 507,923 82	1,226,205 80	+ 1,734,129 62
35,794,649 80	1,009,019 15	36,803,668 95	6,095,217 01	1,290,153 33	4,805,063 68
31,861,961 73	953,264 00	32,815,225 73	25,045,635 80	1,350,500 00	23,695,135 80
43,797,091 22	557,039 59	33,354,040 81	15,809,036 72	1,563,194 84	14,245,841 88
33.177,040 39	302,842 41	33,479,882 80	28,357,685 72	1,606,270 77	26,751,414 95
35.754,993 25	537 66	35,755,530 91	7,748,620 97	1,592,952 62	4,155,668 35
35,908,463 53	.....	35,908,463 53	9,155,660 51	1,939,077 79	7,216,582 72
38,782,870 23	.....	38,782,870 23	4,735,327 83	1,736,644 34	2,998,683 49
39,879,925 41	.....	39,879,925 41	1,890,407 32	1,887,237 20	3,170 12
38,579,310 88	.....	38,579,310 88	2,213,897 31	1,938,078 57	275,818 74
36,921,871 60	.....	36,921,871 60	5,350,264 72	2,027,860 79	3,322,403 93
38,168,608 80	40,000 00	38,208,608 85	2,645,119 06	2,095,513 89	549,605 17
36,374,693 07	190 14	36,374,883 21	6,633,350 68	2,131,360 81	4,501,989 87
33,978,129 47	.....	33,978,129 47	8,894,208 97	2,002,311 36	6,891,897 61
36,618,590 72	.....	36,618,590 72	7,477,793 20	2,055,287 52	5,422,505 68
37,829.778 40	.....	37,829,778 40	5,142,977 49	2,101,813 80	3,041,163 69
40,555,238 03	1,272 03	40,556,510 06	4,777,771 00	2,359,968 55	2,417,802 45
46,741,249 54	1,853 41	46,743,102 95	4,799,532 34	2,482,484 65	2,317,047 69
51,029,994 02	1,472 69	51,031,466 71	1,686,000 13	2,465,639 84	779,639 71
52,514,701 13	1,631 63	52,516,332 76	5,466,533 70	2,480,336 90	2,986,196 80
58,050,790 03	1,543 31	58,052,333 34	5,918,466 52	2,569,380 59	3,349,085 93
66,037,068 93	3,311,015 17	69,348,084 10	+ 7,601,512 29	2,620,588 46	+ 10,222,100 75
1,186,519,325 34	13.972,856 56	1,200,492,181 90	238,976,013 55	53,097,666 05	185,878,347 50

STATEMENT

.. OF ..

Expenditure per Capita

Year	Expenditure, Consolidated Fund.	Population.	Expenditure per capita
	$ cts.		$ cts.
1880	24,850,634 45	4,215,389	5 90
1881	25,502,554 42	4,336,504	5 88
1882	27,067,103 58	4,383,819	6 18
1883	28,730,157 45	4,333,363	6 48
1884	31,107,706 25	4,485,395	6 94
1885	35,037,060 12	4,538,790	7 72
1886	39,011,612 26	4,589,414	8 50
1887	35,657,680 16	4,638,109	7 69
1888	36,718,494 79	4,688,147	7 84
1889	36,917,834 76	4,739,617	7 79
1890	35,994,031 47	4,792,605	7 51
1891	36,343,567 96	4,844,366	7 50
1892	36,765,894 18	4,889,266	7 52
1893	36,814,052 90	4,935,748	7 46
1894	37,585,025 52	4,983,903	7 54
1895	38,132,005 05	5,033,839	7 58
1896	36,949,142 03	5,086,061	7 26
1897	38,349,759 84	5,141,508	7 46
1898	38,832,525 70	5,199,267	7 47
1899	41,903,500 54	5,259,491	7 97
1900	42,975.279 51	5,322,348	8 07
1901	46,866,367 00	5,388,017	8 70
1902	50,759,391 97	5,456,931	9 30
1903	51,691,902 76	5,528,847	. ..

AGGREGATE TRADE OF CANADA WITH FOREIGN COUNTRIES.

Countries.	1899.	1900.	1901.	1902.	1903.
	$	$	$	$	$
Great Britain...	136,151,978	152,526,098	148,347,120	166,526,283	190,099,222
United States...	138,140,687	178,463,401	182,867,238	192,012,434	209,389,119
France	5,447,017	5,743,272	6,979,352	8,061,042	7,921,647
Germany.....	9,613,025	10,099,401	9,162,957	13,515,747	14,380,336
Spain	593,660	647,157	897,893	856,793	962,497
Portugal	92,937	187,801	181,707	234,874	293,376
Italy	520,864	405,029	642,424	963,641	837,555
Holland	872,941	767,781	984,840	1,195,856	1,889,869
Belgium	3,168,136	4,421,716	6,634,592	4,156,049	4,950,732
Newfoudland ..	2,335,323	2,805,398	2,886,067	3,498,482	3,714,157
West Indies ...	4,398,902	4,484,280	4,707,677	5,472,747	6.021,294
South America.	2,631,635	2,402,696	2,567,278	3,440,987	4,532,008
China & Japan.	3,194,849	2,749,757	3,149,591	2,555,462	2,440,999
Switzerland ...	571,526	529,976	603,397	780,183	952,326
Other Countries	5,215,018	6,465,274	7,113,487	11,161,301	11,255,103

TOTAL EXPORTS OF CANADA BY COUNTRIES.

Countries.	1899.	1900.	1901.	1902.	1903.
	$	$		$	$
Great Britain...	99,091,855	107,736,368	105,328,956	117,320,221	131,202,321
United States ..	45,133,521	68,619,023	72,382,230	71,197,684	71,783,924
France	1,557,722	1,374,770	1,581,331	1,388,848	1,341,618
Germany.....	2,219,569	1,715,903	2,141,552	2,692,578	2,097,699
Spain.....	59,178	86,456	155,354	161,823	138,553
Portugal.....	29,641	115,016	85,403	105,495	164,184
Italy	125,265	260,456	315,063	236,899	295,770
Holland	372,548	188,199	187,378	320,241	619,329
Belgium	849,413	1,197,798	2,806,142	2,444,450	2,150,550
Newfoundland.	1,808.317	2,144,070	2,260,499	2,381,082	2,516,576
West Indies...	3,043,963	2,870,343	2,905,937	3,298,912	3,642,176
South America	1,456,051	2,148,499	1,519,190	1,781,913	2,542,056
China & Japan	425,350	368,615	699,569	570,586	501,057
Australia	1,506,138	1,626,441	2,311,405	2,586,554	2,929,861
OtherCountries	1,218.374	7,160,158	1,807,623	5,153,000	3,924,050

CHIEF ARTICLES OF DOMESTIC EXPORT

Year	Products of the Mine	Products of the Fisheries	Products of the Forest *	Animals & Products Thereof	Agricultural Products	Manufactures
1870	$ 2,192,541	$ 3,608,549	$ 5,766,479	$12,138,161	$13,676,619	$18,327,191
1880	2,831,163	6,579,656	3,945,966	17,607,577	22,294,328	16,197,348
1890	4,853,717	8,461,906	6,380,516	25,106,995	11,908,030	25,541,844
1900	24,575,155	11,169,083	4,495,789	56,148,807	27,516,609	39,397,277
1901	40,355,060	10,720,352	4,989,004	55,495,311	24,781,486	41 045,694
1902	34,942,403	14,143,294	4,469,489	59,161,209	37,152,688	46,118,081
1903	31,062,106	11,800,184	5,299,552	69,817,542	44,624,321	51,714,185

* Includes only logs, squared timber, bark, etc. Lumber, etc. is included in manufactures.

DOMESTIC EXPORTS OF LUMBER, EGGS, BUTTER, CHEESE AND GRAIN

Year	Lumber	Eggs	Butter	Cheese	Grains
1870	$15,853,353	$ 314,812	$2,353,570	$ 674,486	$10,457,538
1880	13,318,279	740,665	3,058,069	3,893,366	15,888,183
1890	19,793,580	1,795,214	340,131	9,372,212	7,625,500
1900	25,167,879	1,457,902	5,122,156	19,856,324	18,057,233
1901	25,020,853	1,691,640	3,295,663	20,696,951	14,233,639
1902	27,649,940	1,733,242	5,660,541	19,686,291	23,555,236
1903	31,086,463	1,436,130	6,954,618	24,712,943	29,224,421

THE CATTLE TRADE

IMPORTATION OF LIVESTOCK

The importation of horses, cattle, sheep and swine into the Dominion during the past three years was as follows:—

	1901		1902		1903	
Horses	8,719	No.	17,823	No.	29,598	No.
Cattle	8,323	"	9,524	"	37,528	"
Sheep	83,220	"	139,155	"	79,817	"
Swine	144,478	lbs.	116,066	lbs.	19,745	lbs.

The above were brought in at various points as shown in detail in the official reports of the Chief Veterinary Inspector.

EXPORTATION OF CANADIAN LIVE STOCK TO ALL COUNTRIES

The exportation of live stock from Canada for the years ended June 30, 1900 to 1903 was as follows:—

	1900	1901	1902	1903
Horses	10,053 No.	7,609 No.	12'687 No.	3,878 No.
Cattle	205,524 "	169,279 "	184,473 "	176,780 "
Sheep	359,944 "	394,681 "	348,443 "	401,443 "
Swine	1,634 "	944 "	5,778 "	23,986 "

EXPORTATION OF CATTLE TO THE UNITED STATES

The numbers of Canadian cattle exported to the United States during the four previous years, were as follows :—

1896	1,646
*1897	57,857
*1898	88,605
*1899	85,240
*1900	86,989
1901	46,244
1902	31,746
1903	10,432

The figures of the last five years indicate that the removal of the old regulations which required a quarantine detention of ninety days on cattle entering the United States from Canada has enabled the farmers and stockraisers of the Dominion to find a large market in the United States for their live stock. The total value of the last year's (year ended 30th June, 1903) export to the United States of Canadian cattle amounted to $292,288. These figures do not include the number of cattle imported as settlers effects.

THE EXPORT TRADE

The export commerce of Canada in most of the farm products is increasing at a very rapid rate. The following comparative statement of the value of the exports of some of the farm products of Canada during the years 1896 to 1899, shows the growth in that short period and indicates somewhat of the great possibility for further expansion of this trade :—

VALUE OF SOME CANADIAN FARM PRODUCTS EXPORTED IN YEARS 1896, 1897, 1898, 1899, 1900, 1901, 1902 AND 1903

(Years ending June 30.)

	1897	1898	1899	1900	1901	1902	1903
Wheat	$ 5,544,197	$17,313,916	$ 7,784,487	$11,995,488	$ 6,871,939	$18,688,092	$24,566,703
Flour	1,540,851	5,425,760	3,105,288	2,791,885	4,015,226	3,968,850	4,699,143
Oats	1,655,130	3,041,578	3,268,388	2,148,179	2,490,521	2,052,559	2,583,151
Oatmeal	462,949	554,757	396,568	474,991	467,807	344,332	537,002
Peas	2,352,891	1,813,792	1,955,598	2,145,471	2,482,249	1,805,718	1,052,748
Cattle	7,159,388	8,723,292	8,522,835	9,080,776	9,064,562	10 663,819	11,342,632
Cheese	14,678,239	17,572,763	16,776,765	19,856,324	20,696,951	19,686,291	24,712,943
Butter	2,089,173	2,046,686	3,700,873	5,122,156	3,295,663	5,660,541	6,954,618
Pork, Bacon and Hams	5,871,988	8,092,930	10,473,211	12,803,034	11,829,820	12,457,863	16,029,269
Eggs	978,479	1,255.304	1,267,063	1,457,902	1,691,640	1,733,242	1,436,130

*For the years ended September 30.

The quarantine was removed February 1, 1897.

SILOS AND SILAGE

(Extracts From Bulletin)

BY

CHAS. S. PLUMB, B.S.

Prof. of Animal Industry and Dairying in Purdue University and Director of the Indian Agricultural Experimental Station

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HISTORY.

The silo originally was a pit or room, below or above ground, used for the storing of grain. In very early times in Egypt, Italy, Spain and Mexico seed was stored in such rooms. In so-called dry regions the grain was often covered with straw and the storehouse sealed up with masonry or other material. In damper climates the contents were best preserved when ventilation was permitted. This method was adopted to preserve the grain from insects and moisture, and also to hold it over from years of plenty to times of scarcity of food supply.

The preservation of green food in silos possibly commenced about one hundred years ago. In 1786 Symonds wrote of Italians preserving fresh leaves for cattle in casks and pits in the ground. In 1843 Johnston, an Englishman, published an article on preserving green clover, grass or vetches in pits, basing his statements on observations made in Germany. Pits were dug 10 to 12 feet square and about as deep, the sides lined with wood, and a clay floor made. The green stuff was placed in the pit, and plenty of salt scattered over it from time to time. When the pit was full, the top was well salted and a close-fitting cover of boards was placed over it. Dirt to the depth of a foot or so was thrown on the cover to exclude air. In a few days, after the contents had fermented and settled, the cover was removed and more green fodder was thrown in and the cover again put on. In commenting on the contents of such a pit Johnston notes that the grass when thus fermented had the appearance of being boiled, had a sharp acid taste, and was greedily eaten by cattle.

In England, between 1860 and 1870, Samuel Jonas stored tares or rye, cut green and chaffed, and fed the fermented material on an extensive scale.

Adolph Reihlen, a sugar manufacturer of Stuttgardt, Germany, probably stored the first green maize in pits. He also preserved green beet leaves and beet pulp in silos with much success. He had lived a number of years in the United States, and on his return to Germany experimented with large dent corn, the seed of which he carried with him from this country. As the crop did not always mature in that climate, the green crop was pitted after the manner of the beet refuse. This work was conducted between 1860 and 1870, and the results were published in the German and French papers of the time.

The use of the silo was strongly urged upon the people of France, and considerable attention was given to the subject. Many farmers built silos on the basis of Reihlen's experience. In 1877 A. Goffart of France wrote a book on "ensilage," which was translated into English and published in New York a year or two later.

The first to prepare silage in the United States were Manly Miles of Michigan, who built two silos in 1875, and Francis Morris of Maryland, who commenced experiments in this line in 1876. Several other silos were also built by people in the Eastern States within the next few years. In 1882, in a report on silage by the United

States Department of Agriculture, statements were published from 91 persons who had silos. These were located as follows: Massachusettes 28, New York 21, Vermont 11, Connecticut and New Jersey 5 each, Maine 4, Wisconsin 3, New Hampshire, Maryland, Virginia, and Canada 2 each, and one each in Rhode Island, Kentucky, Tennessee, North Carolina, Iowa and Nebraska. No doubt numerous others were in use at that time.

At the present time the silo is found on many thousands of farms in the United States, especially in dairy regions, and it may be considered a well-established fixture in American farm economy where stock feeding is practiced.

CONSTRUCTION AND COST OF SILOS.

The first silos made in the United States were of stone or brick. The walls were thick, very strong, and were covered with a smooth coat of cement on the inside. These were very expensive; consequently wooden silos were tried, and it was found that very satisfactory results could be secured with these at a much less cost than with stone or brick silos.

In constructing a silo it will be well to keep in mind the following points:

Make the silo deep, for the greater the depth the greater will be the pressure on that below, thus forcing out air from the fodder and insuring better silage. Shallow silos as a rule give less satisfactory results than deep ones, as there are larger air spaces in the silage, owing to lack of pressure. Wherever practicable the silo should have a depth of not less than 24 feet, while more satisfactory results may be expected if it is 10 feet deeper. If necessary the silo may extend 4 or 5 feet below the surface in order to obtain such a depth. It must, however, be borne in mind that good silos may be built 20 feet and even less in depth.

Make the silo walls smooth.—After the silage is placed in the pit, it should settle evenly and easily. If the walls are perfectly vertical and smooth, the conditions for settling will be favorable. Where stone is used, a coat of water-lime cement must be used to make a good surface. As silage contains acid, this smooth surface will gradually become eaten and rough, so that from year to year, as seems necessary, a light wash of cement should be brushed over the wall to make it smooth. Where wood is used, the lining boards should be dressed on one side. The wall on the inside should be perfectly plumb and smooth from the top of the silo to the foundation wall, from the top of which there may be a slight bevel to the floor. There should be no blocks or rods against the walls at any place to prevent the uniform settling of the contents. In any form of wooden silo, excepting the round, it is desirable that the inside lining boards be nailed on vertically. The silage will then slip down more easily than where it rubs against the edges of the boards nailed on horizontally.

Have as few corners as possible.—Upon the thoroughness of the packing usually depends the character of the preservation. Most of the waste which occurs where silage has been well put in occurs at the surface, against the doors, at the sides, and in the corners. The corners are difficult to pack well; hence a loss is often found there. One of the advantages of a round silo is the absence of corners. In the square or rectangular form the corners may be filled in with triangular pieces or boarded over for about 12 inches. If the foundation wall is only 2 or 3 feet high, it will be desirable to bevel from its upper inside edge to the floor, thus reducing the floor corners. If the door boards fit smooth and flush with the inside of the wall, there should be but little decay of silage there.

Use gas tar on wooden silos, for when applied hot it is considered the best known preservative of wood available for common use. Even put on cold, if not too thick for rapid painting, it is a superior preservative. Tar may also be thinned with gasoline without the use of heat. As gasoline rapidly evaporates into a gas which is very inflammable, much care should be used not to expose it to fire. The edges, ends and sides of the inside linings can be tarred to advantage. As the moisture coming from the silo is acid and tends to promote the decaying of wood, the use of a preservative is especially desirable. Consequently, the more completely the timber used is tarred the better fitted it will be to resist decay.

FORM OF SILO.

The two most desirable forms are round and square. The round silo contains the least amount of waste space, and presents the greater strength, for an equal pressure is distributed against the walls at every point from the centre, so that it can not press out or bulge. Taking equal capacity into account, the round silo requires less lumber than the other forms. The square silo may be built to advantage in the corner or bay of a barn, where it would not be advisable to place a round one. If to be built to stand by itself, with walls independent of a barn, the square form is preferable to the rectangular. The walls are stronger. For equal capacity there is less waste space in the square. When of the same depth and including equal amounts of side exposure, the square form will hold very much more silage than the rectangular.

Inside linings of numerous kinds have been tried. Where stone or brick is used, the final dressing should be of Portland cement with a very smooth finish. The contents of such a silo may be expected to keep well. King considers that such a cement wall will last ten years, and where a yearly washing of cement is applied it will last twenty or thirty years.

Lathed and plastered silos have not been a general success. In those cases known to the writer the plaster has suffered from cracking or has been injured by the fork. The plaster also softens from the acid of the silage. Moisture finally makes a passage through the plaster and injures the woodwork, which begins to decay.

Inside linings of sheet iron or roofing tin are not entirely satisfactory. The metal rusts, even if coated with paint or coal tar, since it is difficult to prevent abrasions of the coat during the season of use. Further, the action of the acid injures the efficiency of the paint for the purpose intended. Roofing tins usually are coated with lead, from which deleterious effects may be expected, as the lead compounds are poisonous. At the Wisconsin Station two silos were lined with metal—one with tin and the other with sheet iron—and these were discarded after a brief trial as unsatisfactory.

The best inside lining, all things considered, would seem to be two layers of boards with tarred paper between. The first layer should be placed horizontally against the studs. Over this should be placed the paper. If the silo is square or rectangular, the next layer of boards should be placed vertically on close edges. If the silo is round, the second layer should go on horizontally, with the strips nailed so as to break joints with the first layer. In the round form boards one-half inch thick by 4 to 6 inches wide should be used.

MISCELLANEOUS SUGGESTIONS.

The floor may be made of stiff clay with some grout work in it to keep rats from burrowing up into the silage. If clay is not available, 3 or 4 inches of grout should be laid. The main object is to make a firm, smooth, close, rat-proof floor. A layer of concrete is highly recommended.

The walls of wooden silos remain sound longest when they are well ventilated. Where they are carefully boxed up, moisture accumulates within and decay occurs. Auger holes bored between studs at he bottom give sufficient ventilation if there are openings at the top of the wall. All these holes or openings should be covered with wire screen to keep out rats and mice. The studs should be strong so as to guarantee against springing under the great pressure to which they are subjected.

The feeding door should be about 2 1-2 to 3 feet wide, and extend in sections from the sill to within 3 or 4 feet of the top, each section being about 5 feet long. Portions of the wall 2 to 3 feet wide should be left between the sections of the door at sufficient intervals to make the wall perfectly strong. Some persons prefer iron rods for this purpose, and then have a continuous line of doors from top to bottom. Boards as long as the door is wide must be placed horizontally in the frame, edge to edge and flush with the inside of the silo, resting against cleats nailed on the inside of the casing. These boards may be put in place as the silo is filled. The studs on each side of the door should be reinforced to give sufficient strength to the silo wall at this point.

The foundation wall should extend be-

low frost line, and be 18 inches thick. The situation ought not to admit of water draining into the silo at any time.

Weatherboarding is not essential on the outside of the silo to preserve the contents. The writer has seen one large round silo with no weatherboarding whatever. The cost of the dressing outside of the studs is thus saved, but a silo so left is not an attractive-looking farm building. It is important to note, also, that in the colder parts of the country, where severe freezing occurs, a good covering outside of the studs reduces the freezing. Warm silage is more palatable than that permeated with frost.

Square or rectangular silos should be tied across the top by joists or cables to opposite studs, to keep the walls from spreading. In a silo 15 feet long two ties would be ample, and one might do.

Partitions are objectionable unless in shallow silos. They reduce storage space, are inconvenient and along the walls and in the corners caused by them usually occurs more or less waste silage.

The sills, well tarred, should rest on a good foundation and be bedded in cement or mortar. It is important to have sills well above the soil on the outside, and at least a foot above the floor on the inside. In the square or rectangular forms, they should be anchored to the wall so as not to spread. This is usually accomplished by placing strong bolts in the wall when laying it, arranged to extend up through the sill. This is unnecessary with round silos.

A roof is required only on silos built out of doors, independent of buildings. The cost of the roof is largely a matter of taste. Rain and snow, however, should be excluded from the silo, and if a close roof is placed on the building then a cupola or window should be built with a view of giving good ventilation. It is also essential to have a dormer window or door in the roof through which to fill the silo. This should be wide enough to admit the end of the carrier and allow a person to pass in by the side of the latter.

The capacity of the silo should depend on the needs of the farmer. A cubic foot of silage under average conditions will weigh 35 to 40 pounds. Ordinarily, this amount is enough, with other food, for a day's feeding for one cow. If silage is fed one cow 200 days, she will consume 8,000 pounds or 4 tons. Ten cows will consequently require 40 tons. Allowing for some waste and emergency conditions, 50 tons would be a liberal estimate for these animals.

For a round silo 30 feet deep, King gives the following dimensions for herds of different sizes, estimating 5 square feet of surface silage for 1 cow:

30 cows, 150 square feet, inside diameter silo 14 feet.
40 cows, 200 square feet, inside diameter silo 16 feet.
50 cows, 250 square feet, inside diameter silo 18 feet.
60 cows, 300 square feet, inside diameter silo 19¾ feet.
70 cows, 350 square feet, inside diameter silo 21¼ feet.
80 cows, 400 square feet, inside diameter silo 22¾ feet.
90 cows, 450 square feet, inside diameter silo 24 feet.
100 cows, 500 square feet, inside diameter silo 25¼ feet.

SELECTION AND CULTURE OF SILAGE CROPS.

The plants most available for silage in the United States are Indian corn, red clover, rye, oats, wheat, sorghum, the millets, and alfalfa in the North, and soja beans and cowpeas in addition to the above in the South.

Indian corn is the great silage plant of America. It is adapted to a wide range of latitude and longitude, and will produce the largest amount of desirable silage per acre of any crop we can grow. Fifteen to twenty tons of green fodder can be grown on an acre without difficulty over a large part of the United States.

All the large varieties of corn are suitable for silage, but some are preferred to others. The important point is to secure as many tons of food per acre as is possible. The larger dent varieties are the favorite ones for silage. Burrill and Whitman is one of the best known varieties, but for regions in the northern corn belt it does not mature soon enough to be entirely satisfactory. As a rule, the best corn

for the silo, in any locality, is that variety which will be reasonably sure to mature before frost, and which produces a large amount of foliage and ears. Wisconsin Yellow Dent does well on the northern line of dent corn growing, while Burrill and Whitman, Leaming, and Dungan White Prolific will do well farther south. The common Southern Horse Tooth and Mosby Prolific are well adapted to the Southern States and are heavy yielders.

In preparing the soil, only the best of tillage and cultivation should be practiced. The soil should be fertile to yield an abundant crop of strong plants. The seed may be planted in drills 1 foot apart, in rows 3½ to 4 feet apart, according to locality. The cultivator may be started to advantage as soon as the young corn breaks through the surface, and the soil kept stirred and weeds destroyed, until cultivation is no longer practicable. It is a common practice now for some owners of silos to draw upon the general cornfield to fill the silo, not planting any special variety for this purpose.

Many experiments have shown that silage corn contains the most nutriment when the kernels begin to glaze, or when denting is well established, and before the lower leaves become dry. If cut before this period, too large a percentage of water is harvested in the crop, while the greatest development of food substance in the plant has not yet been reached.

Red clover has been stored green in the silo, but to a limited extent. This plant, if well preserved, makes the best of feed. There is no waste unless from decay. Horses, cows, and sheep relish it, and pound for pound clover contains more nutriment than corn or sorghum. The objections to storing clover in silos are—first, owing apparently to its rich composition, clover, unless well handled and stored, generates much heat, and often becomes injured in quality; second, corn will far outyield the clover in amount per acre. To make bright, sweet, aromatic clover silage, the crop must be cut when the plants are free from dew and when fairly well in bloom, and placed in a silo of good depth to insure its being well packed. Doubtless many valuable crops of clover could be saved from rain at harvest time by being put into the silo at the right time. It is not necessary to run clover through the fodder cutter before placing in the silo; but it is desirable, as it will pack better and can be handled more advantageously for feeding.

Sorghum has been used to some extent for silage, but as a rule it has not been entirely satisfactory when compared with corn. The plant lacks the nutritive quality of Indian corn, and the stalk is so hard that even when cut in short lengths it is not eaten with comfort by stock. Sorghum, however, will remain green later in the fall than corn, thus extending the time for filling. Nevertheless, corn and clover are superior to sorghum for silage. A process to be recommended is the cutting of cowpeas or soja beans and placing them separately or together with the corn in the silo. This gives a more nutritious silage than corn alone. The average farmer would be more likely to preserve the peas or beans in a silo with corn than if placed in it alone. Canada field peas also make very nutritious silage.

There is no question but most green crops can be successfully ensiled; of these, taking all things into account, corn is decidedly the best.

FILLING THE SILO.

When corn is used, the entire plant, including the ear, should be placed in the silo.

The practice of cutting the crop by hand is general, although it may be done by horsepower. Harvesting machines of various patterns are made. Self-binders have been recommended, using them to cut one row of corn at a time. The most common form of harvester is a sled or drag of Λ form, with knives fastened to the edges or wings. This is drawn by one horse between two rows, the knives cutting the stalks near the ground. When not in use, the wings may be folded up over the centre of the machine. One or two men ride on or walk beside the machine and gather the stalks into armfuls as cut, and place on the ground or on a wagon as convenient.

Numerous forms of wagons are used for carrying the crop from the field, but

it is advisable, if possible, to use a low wagon, so as to save as much lifting as possible. Wagons of this character are sold in the market, or one can have special small wheels, with tires 4 or 6 inches wide, made for putting on a common farm wagon.

At one time it was considered advisable to allow the corn to wilt in the field before putting in the silo, it being thought to keep better. This practice is no longer considered important, and many silos are now filled most successfully as fast as the crop can be drawn from the field and cut.

Rapidity of filling is unimportant, so long as fresh fodder is placed in the silo before mold is formed at the surface.

Corn may be placed in the silo uncut, but this practice is objectionable. The stalks will not pack as closely as the cut fodder, and it is not so convenient to handle or economical for feeding purposes. The fodder cutter should be placed so as to deliver the cut material as near the centre of the silo as possible, so that it may be distributed evenly all over the pit. Carriers of different lengths may be purchased of most firms manufacturing fodder cutters, so that the material can be placed where wanted. The shorter the fodder is cut the more satisfactory it is for feeding. One-half inch is a very common length.

It is desirable to have a careful person inside the silo to distribute the fodder and trample well at the corners and along the sides, thus having the contents evenly and thoroughly packed during filling. The silo should be filled above the top edge, as the silage will settle considerably below it during the process of fermentation or heating. Temporary boards may be placed above the edge for a few days, or fresh silage may be added to fill up the settled space, provided the contents have not molded at the surface.

When the process of ensiling was first introduced in America it was customary to place a close layer of boards on the surface of the silage, over which was placed a heavy weight. The idea was to press the silage as heavily as possible and exclude the air. The weighting process was found to be unnecessary, however, and this has been generally dispensed with. After filling, some persons begin feeding out from the top at once, thus preventing all waste at that point. Others place cut chaff or straw on the silage to a depth, when settled, of 6 inches to 1 foot. This prevents the decay of the silage. Perhaps the most satisfactory method is to place a layer of tarred paper smoothly over the surface of the silage and then cover this to a depth of a foot or so with cut straw.

When the corn is cut in a very dry season and is not ordinarily juicy, it will be advisable to pour considerable water on the silage after the silo is filled, especially when the contents are at a high temperature.

In making silage it is important to have as much dry matter in it as possible without injuring the character of the feed. Some years ago it was the practice to cut the corn plant when somewhat less mature than is now considered the proper state for silage, so that it probably contained more water than average silage now does.

CONCLUSIONS.

From a practical standpoint, the value of silage as a food may be shown in several ways. It is as easily digested as the same plant preserved dry. It keeps the digestive system in a state of healthy activity, thereby aiding digestion. It is generally considered that horses and cattle fed silage show the beneficial effects of this food in the more healthy condition of the skin, as evidenced in its pliable, mellow condition, and the softness and luster of the coat of hair. Animals usually eat sound silage with a relish, and reject it only when decay is present. For milch cattle it seems especially well adapted, and the silo has proved an important and economical addition to the dairy farm.

The effects on the milk and butter through feeding silage to dairy cattle was inquired into by the Royal Commission appointed in England. The findings of this commission were as follows:—

	Effect on—	
	Milk.	Butter.
No change	22	1
Improved in quantity and quality	95	18
Decreased in quantity and deteriorated in quality	1	....
Increased quantity	93	13
Decreased quantity	5	2
Improved quality	34	26
Deteriorated quality	5	3
Improved quality and decreased quantity	4	....
Increased quantity and deteriorated quality	5	....
Favorable results (whether in quantity or quality not stated)	30	15
Unfavorable results	.....	1

This important testimony generally favors the use of silage for dairy cattle.

Though not extensively used for the purpose, silage forms a valuable addition to the rations of sheep, and serves as a good and cheap substitute for roots. Its use as food for swine has not been successful.

Silage provides succulent food for farm animals at a time of year when vegetation is dead, and so in a large degree replaces pasturage.

It is not desirable or advisable to depend on silage alone for rough food. It should be fed only in a limited way in connection with hay and grain. For matured cattle, 25 to 35 pounds per day is a reasonable alllowance. Horses should have less, and sheep only 2 or 3 pounds each.

Of the green fodders suited to silage, Indian corn, all things considered, is best and cheapest.

The proper time to harvest any green crop for silage is at maturity, before the leaves turn brown and when the water content of the plant begins to diminish.

Generally speaking, 3 tons of silage are equal in feeding value to 1 ton of hay. On this basis a much larger amount of digestible food can be secured from an acre of silage corn than from an acre of hay. The food equivalent of 4 tons of hay per acre can easily be produced on an acre of land planted to corn.

The silo provides a more economical and compact method of storing fodder than the hay mow. A silo of 180 tons capacity which will contain 54 tons of dry matter will hold less than 23 tons of red clover hay containing less than 20 tons of dry matter. The advantage of storage capacity clearly rests with the silo.

The silo is especially adapted to intensive farming, where land is high in value and storage space is limited.

A carelessly constructed silo is an extravagance. A well-made one is an economy. Temporary structures are not advisable.

THE LIMING OF SOILS

(Extracts from Bulletin)

—By—

H. J. WHEELER, Ph. D.

Chemist of the Rhode Island Agricultural Experiment Station

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THE USE OF LIME FOR IMPROVING SOILS.

The recognition of the agricultural value of certain forms of lime is not new, and it appears probable from the writings of Pliny that liming was practiced by the Romans more than two thousand years ago. In England, Germany, France and other European countries the application of lime in various forms has been and is still practiced extensively.

Deherain states that certain regions of France have undergone a veritable agricultural transformation owing to the use of lime and marl. Muntz and Girard assert that more than one-fifth of the area of France is of granitic origin, and that when the soils are supplied with lime and phosphoric acid, which they lack, they undergo a complete transformation.

In certain sections of Germany carbonate of lime in the form of marl plays an important part in maintaining the fertility of the soil. According to Wicke, the yields in certain districts of Germany have been quadrupled by the employment of marl, and many plants whose cultivation was previously impossible can be grown at a profit after the soil has been limed.

That eminently practical as well as scientific agriculturist, Schultz, of Lupitz, has demonstrated the immense value of marl in developing the productiveness of the light soil of that section of Germany. By its use, in connection with abundant potash and phosphoric acid, he has caused leguminous crops to gather from the air large stores of nitrogen, thus making it possible to cultivate the light soils at a profit.

Haxton, in a prize essay "On light land farming," mentions a number of siliceous, sandy soils in various parts of England which are greatly benefited by liming ,and in speaking of the granite formation in Scotland asserts that "the whole the granite soils are deficient in lime, and the first step toward their improvement, after being drained, is to apply this substance in a hot or caustic state."

Ruffin is perhaps the most prominent of the earlier writers who called attention to the agricultural use of lime in the United States. As early as 1818, and later in 1821, articles on the subject were contributed by him to the American Farmer, and in 1832 appeared the first edition of his well-known work on "Calcareous manures." He cites many instances showing the benefit derived from calcium carbonate when applied in the form of marl to his own and other Virginia estates.

In certain parts of Pennsylvania and New York lime has long been considered one of the essentials in wheat production. The beneficial effect of liming has been demonstrated in other parts of the United States, especially in the eastern portion, but, as Roberts states, probably 99 per cent of the arable soil of the United States has never been limed. The work of some of the experiment stations, notably that of Rhode Island, has shown that soils which respond profitably to liming, either on ac-

count of their acid condition or of a deficiency of lime, are very widely distributed.

DIRECT MANURIAL ACTION OF LIME.

Authorities seem to agree that lime is necessary to the plant, and if it be wholly lacking in soils, even though an abundance of all the other essential elements is present, it can not develop normally. Just as a chain is useless with a missing link, so the plant cannot grow if one of the essential elements of plant food is lacking. As already stated, lime has been found to be especially deficient in soils derived from granite. It is also often true of soils derived from mica-schist and standstone. Fortunately, however, many soils are well provided with lime by nature, and it is seldom or never necessary for those who cultivate them to resort to liming. It would be just as irritional to apply lime where it is not needed as to omit it where it is required, and hence arises the necessity of ascertaining the needs of particular soils in this respect.

The method usually resorted to for ascertaining the amount of lime in soils is to treat them with some strong mineral acid (usually hydrochloric) and determine the amount of lime which is thus dissolved. Some writers state that if only one-half of 1 per cent. is thus shown to be present immediate resort to liming is desirable; others set the amount higher, and some seem to prefer to have present as much as 1 per cent. It is possible that a soil may contain considerable quantities of lime thus removable by acid, and yet in actual practice show much benefit from liming. As a matter of fact, soils of limestone origin sometimes show benefit from liming. This seems to be due to the fact that a considerable amount of lime compounds, soluble in hydrochloric acid, may exist, and the soil be nevertheless so charged with inert organic matter or so acid that the profitable production of certain crops is an impossibility.

The fact that beets of all kinds make a ready response to liming on soils which are deficient in lime may be utilized as the basis for a practical and reliable method of testing the lime requirements of the soil. For this purpose lay out two plats of land, each about 12 by 30 feet, manure each of the plats with like amounts of a fertilizer containing potash, phosphoric acid, and nitrogen, and apply lime to one of the plats at the rate of from 1 to 2½ tons per acre (40 pounds per plat would be approximately 2½ tons per acre). A comparison of the growth and yields on the two plats will furnish a safe means of judging whether the soil will respond profitably to applications of lime.

CHEMICAL ACTION OF LIME ON SOILS.

Lime is said to take the place of potash in certain chemical compounds which exist in soils, thus liberating the potash and placing it at the disposal of plants. In this particular, gypsum (land plaster or calcium sulphate) is believed to act more energetically than carbonate of lime, air-slacked or water-slacked lime.

When soluble phosphates are applied to soils deficient in lime and magnesia the phosphoric acid combines with the iron and alumina of the soil to form compounds which are not readily utilized by plants. If, however, the soil is fairly well supplied with lime and magnesia this transformation is retarded so that the plant is afforded an opportunity to utilize much of the phosphoric acid before it becomes unassimilable. If a soil containing a certain inert phosphate of iron is heavily limed, it is believed that this phosphate will be changed into a form which the plant can utilize. Lime may therefore not only help to maintain fresh applications of phosphoric acid for a long time in assimilable condition, but it may, if applied in sufficient quantity, help to unlock stores of phosphoric acid which plants would otherwise be unable to use.

Hilgard has abundantly demonstrated the great value of gypsum (land plaster) in renovating "alkali" soils in the arid portions of the United States. Wherever too much sodium carbonate (black

alkali) is the cause of the unproductive condition of the soil the gypsum reacts with it, producing sodium sulphate and carbonate of lime, whereby the alkalinity may be sufficiently reduced to render possible the profitable production of crops.

In case protosulphate of iron and certain other poisonous compounds are present in soils, liming so changes them as to render them harmless to plants.

When the remains of plants undergo decay upon soils deficient in carbonates of lime and magnesia, acid or sour humus is liable to be produced, which is particularly noxious to most agricultural plants, though perhaps helpful to the growth of lupines and a few others. Such conditions are liable to occur even in upland and naturally well drained soils. Liming is in all such cases an effectual and probably the most economical remedy.

PHYSICAL EFFECTS OF LIMING.

Many clay soils when wet by rains are not porous enough to allow the water to pass through them with sufficient rapidity, in consequence of which they become water-logged and the air which is necessary for the healthful development of plant roots within the soil is excluded. In times of drought, also, such soils cake readily, thus becoming more difficult to till and less adapted physically to the growth of plants. Liming is an effective preventive or remedy for all of these unfavorable conditions. Upon certain loamy soils containing considerable clay liming often renders the surface more friable and less liable to form a crust upon drying.

The improvement of drainage brought about by liming is one of the most effective means of preventing surface washing. When heavy rains occur on limed soils the water sinks into the soil instead of rushing over the surface, carrying the fine soil particles with it and thus producing galls and washes.

Soils which are composed of siliceous sand are frequently benefited by being rendered more compact by liming. On such soils carbonate of lime is preferable to air or water slacked lime, owing to the caustic nature of the latter, and the best material to employ where it is obtainable is a clay marl containing a fair amount of carbonate of lime. The clay as well as the lime tends to materially improve the physical condition of the soil. It should also be the aim to increase the amount of organic matter in such soils by the use of muck and stable manures, or by the occasional plowing under of a green crop or of sward.

THE EFFECT OF LIME ON THE ACTION OF MICROSCOPIC ORGANISMS IN THE SOIL.

Many important changes are produced in the soil by organisms so small that they can only be observed by the aid of the most powerful microscopes. Some of the changes of this character in which lime plays an important part are the following :

(1) The change of ammonia and of nitrogen in organic matter, such as blood, meat, fish, tankage. plants, etc., into nitrates, the form in which it is chiefly assimilated by most cultivated plants. This is known as the process of nitrification and is promoted by the presence of lime in soils.

(2) The decomposition of organic matter in muck and other soils. In this process the production of carbonic acid is much accelerated by the use of lime. This carbonic acid in turn so acts upon the inert plant food of the soil as to make it more quickly available to plants. The indirect result, therefore, is to help the plant to draw more potash, phosphoric acid, etc., from the soil than would other wise be possible.

(3) The utilization of atmospheric nitrogen by certain of the leguminous plants (notably the clovers), particularly upon sour soils, is facilitated by the application of lime.

LIMING SOMETIMES INJURIOUS.

Excessive amounts of lime, especially on light soils, may have an injurious action. This is particularly true of freshly slacked lime upon light sandy soils containing but small amounts of organic matter. It hastens unduly the decomposition of the organic matter, and thus renders the soil more open and less retentive of fertilizers and moisture than

before. If freshly slacked lime must be used upon such soils it should be applied in small amounts and at not too frequent intervals. As stated heretofore, clay marls are much better adapted than other forms of lime for the improvement of such soils. In lieu of such marl, wood ashes or lime which has been exposed to the action of the air for a long time, might be preferable to lime freshly prepared.

Before the advent of complete fertilizers it was a common adage that liming "makes rich fathers and poor sons." If lime is used alone it serves to liberate potash, nitrogen and perhaps sometimes phosphoric acid, and the extra drain of increased crops on the soil naturally leaves it finally in a worse condition than at the outset. In other cases the soil reverts after many years to its former state of unproductiveness without appreciable injury. Continued success from liming can only be obtained by the use of the other essential manurial fertilizing constituents in connection with the lime. Few, if any, cases are on record where soils originally in need of lime have failed to continue to give good results from liming when care was taken to maintain a supply of the other essential constituents and where lime was applied in moderate amounts.

There are impure forms of lime which, after burning, will harden like cement, and which on this account may have an injurious action upon the soil. If pulverized without burning, they are capable of yielding good results.

Dolomitic (magnesian) limestone contains widely varying percentages of magnesia and lime. Such stone if containing high percentages of magnesia may sometimes prove objectionable if used exclusively. When such material is applied to soils the lime is removed by crops and the drainage water more rapidly than the magnesia, and if the lime thus becomes practically exhausted the residual magnesia in the soil may have an injurious action. This can, however, be overcome by adding more lime. Rather than use such lime for long periods of years on the same land, it would be preferable to alternate frequently with lime containing little or no magnesia.

Some magnesia in lime is by no means objectionable, and may, on certain soils, prove positively beneficial.

PLANTS BENEFITED BY LIMING.

The following are some of the plants which, in experiments on acid soils at the Rhode Island Experiment Station, have shown marked benefit from the use of lime: Spinach, lettuce, beets (all kinds), gumbo (okra), salsify (vegetable oyster), celery, onion, parsnip, cauliflower, cucumber, eggplant, cantaloupe, asparagus, kohl-rabi, cabbage, dandelion, Swedish turnip, pepper, pea, peanut, martynia, tobacco, sorghum, alfalfa, clover, barley, wheat, oats, timothy and Kentucky blue grass. Not only was the crop greater, but in many instances it was ready for market much earlier where the soil was limed. There was at least two weeks difference in kohl-rabi in this respect. Tobacco not only made a much better growth when limed, but the ash was much lighter in color.

PLANTS INJURED BY LIMING.

A few plants have shown considerable injury from the use of lime; these are, serradella, watermelon, blue lupine and common sorrel (Rumex acetosella). Only one season's results are on record with serradella, but the other plants have been tested for several seasons with the same result. Extensive European tests have also shown the lupine to be injured by liming. Though common sorrel is directly injured by liming, the chief effect of lime in ridding land from sorrel seems to be attributable to its favoring the growth of cultivated plants to such an extent that the sorrel is smothered by them.

PLANTS NEARLY INDIFFERENT TO LIMING.

Standing between the two groups of plants given above are a number which when they are supplied with all of the nitrogen they require in a readily assimilable form, such as nitrate of soda, show little or no benefit from liming. Among those are Indian corn, common millet, Hungarian, golden millet, rye, potatoes, carrots, Rhode Island bent (grass), and

redtop (grass). On a very acid or sour soil even those plants would be benefited by lime by virtue of its helping to change the nitrogen into readily assimilable nitrates, provided sulphate of ammonia, blood, tankage, fish, cotton-seed meal, plant roots, etc., were present as sources of nitrogen.

The above tests, carried out at the Rhode Island Station, were made in the field upon a soil well supplied with super phosphate, muriate of potash and nitrate of soda, and also in some of the later tests with magnesia.

INFLUENCE OF LIME UPON SOME PLANT DISEASES.

Potato scab.—It has been shown that carbonate of lime and such other forms of lime as are changed into the carbonate by decomposition within the soil all tend to favor the production of potato scab, provided the germs of the disease are already in the soil or are introduced into it on the seed tubers. This seems to be due to the fact that the lime makes the soil alkaline, or to some influence which the combined carbonic acid of the carbonate of lime exerts upon the development of the fungus.

In view of this unfavorable action of lime, caution should be observed in liming potato fields. If such fields are to receive the treatment, they should be limed, if possible, some time before potatoes are to be grown. The seed tubers employed should also be treated before planting with corrosive sublimate solution or some other effective fungicide.

Club root.—Many writers seem to agree that liming is capable of lessening materially the injury to turnips, cabbages, etc., caused by the disease known as "finger-and-toe" and "club root." English writers assert that by resort to liming excellent crops of turnips have been produced where without it the crop was a failure owing to the attacks of the disease.

Other diseases.—The effect of lime in different forms has been tested, with not entirely conclusive results, on various other diseases, including cranberry and sweet potato diseases, and a root disease of alfalfa (Rhizoctonia medicaginis). Slacked lime was found to be effective in reducing soil rot of sweet potatoes, and quicklime in checking or preventing the root disease of alfalfa.

HOW OFTEN SHOULD LIMING BE PRACTICED?

The frequency with which liming should be practiced depends upon several conditions; for example, upon the character of the soil, the quantity of lime employed in each application, the number of years involved in a rotation, the plants to be grown and their order of succession. Formerly, in England, large quantities of lime were applied at somewhat rare intervals, but there and elsewhere at the present time the preferable practice seems to be to use small amounts and apply it more frequently. As a general rule it may be stated that from haf a ton to one and a half tons of lime per acre applied every five to six years is sufficient. There may exist extreme soils requiring either more or less than these amounts. If soils which are quite acid and have not previously been limed are to be seeded, with the intention of allowing them to remain in grass for several years, as much as two or three tons of lime per acre may be advisable. Only very extreme cases would call for larger applications. If in a rotation covering a considerable number of years two crops especially benefited by lime are introduced at about equidistant intervals of time, it may be advisable to lime twice in the course of the rotation, each time just prior to their introduction. In renovating acid pastures and meadows it is usually preferable to apply a fair amount of lime upon the furrows when they are first plowed so that this may be thoroughly mixed with the soil by subsequent plowing and harrowing, and just prior to seeding to grass make another generous application. By such treatment, provided the other essential fertilizing ingredients are employed, a good stand of clover, Kentucky blue grass, timothy and other grasses may be obtained where in many instances they were formerly partial or total failures and where only redtop, Rhode Island bent, and grasses having similar soil adaptability could be grown. Where

land is kept in grass for a number of consecutive years, top-dressing with lime may be advisable, particularly if ordinary commercial fertilizers are employed in lieu of stable manure.

WHEN TO APPLY LIME.

Lime in the form of carbonate of lime as in marl, wood ashes, etc., can usually be applied with safety in the spring or at any other season of the year, but autumn is always the safest time to apply caustic or slacked lime. The latter form changes gradually into carbonate of lime, which is not caustic, upon exposure to the air, but usually a considerable quantity has not yet reached that stage, when applied, and it may in consequence act too energetically. This is particularly true if the soil is light and sandy, and if plants, which are but little helped by lime, are employed. On very acid soils, particularly such as contain much humus, there is little or no danger from applying reasonable quantities of lime in the spring. If caustic or slacked lime is applied in excessive amounts it may not only injure plants directly, but also indirectly by rendering the texture of the soil unfavorable; it may also make the soil temporarily so alkaline as to interfere with the activity of the organisms which transform ammonia into readily assimilable nitrates. Injury thus arising cannot ordinarily be of long duration, for the reason that the carbonic acid of the soil changes the caustic lime rapidly into carbonate of lime, and thus the alkalinity of the soil is soon reduced.

HOW TO APPLY LIME.

Some writers recommend that upon old mossy meadows and pastures lime should be applied to the surface before plowing, in order that it may help to quickly decompose the organic matter. The chief objection to this procedure is that the lime does not become well incorporated with the soil, and since some of it is turned to the bottom of the furrow and its tendency at all times is to work downward, it may be quickly carried not only away from the surface soil, but also from the reach of plants. The practice of liming such soils immediately after plowing and then thoroughly harrowing has been attended by excellent results. This is particularly the case provided a second application is made in a similar manner, just previous to reseeding. Under such a plan some lime becomes intimately mixed with the entire mass of soil by the operations of tillage, and finally a considerable amount is left near the surface, thus accomplishing two important objects.

In some sections where marl is extensively used it is spread upon the surface and plowed under, turning a furrow about 2 inches deep. The more common method where marling is practiced is to plow the land and then cart on the marl, dumping it in heaps at such intervals that it can be spread conveniently with a shovel. If the marl is not sufficiently fine and is of such a nature that it crumbles upon exposure to the air, the heaps may be allowed to remain for some time before spreading, and till further time may be allowed to elapse before the operation of harrowing is begun. Sometimes a "clod crusher" or "bush harrow" may be employed to advantage to break up the lumps before harrowing. A most important point to be observed in applying lime in all of its forms is to mix it with the soil as thoroughly as possible, the finer the particles the better being the result.

Lime which is already slacked may be spread upon the soil directly from wagons or carts, or dumped in heaps and then spread with a shovel, though the most satisfactory plan in such cases is to employ an ordinary grain drill with fertilizer attachment or a lime spreader. In the use of such spreaders it is generally advisable to attach some burlap or old bagging to the sides and rear of the machine in such a way that it will trail upon the ground. If the machine is so equipped and the burlap is weighted with a piece of wood at the rear, much of the unpleasantness connected with spreading lime is avoided. For those familiar with the nature of lime and its use it is unnecessary to state that it is well, if possible, to apply it on a quiet day. The eyes may be protected by glasses and the nostrils and mouth by

devices used by those who run threshing machines.

The only other form of lime in connection with the application of whch any particular difficulty might be encountered is quick or burned lime. Where only small quantities of caustic lime are to be used it is frequently immersed for a moment in water, in a basket, and emptied into a wagon body. The following day it will be slacked sufficiently for use. Where larger quantities are used, and a lime spreader is at hand, the lime is sometimes water slacked in large piles on the border of the field and then distributed. To accomplish the water-slacking in a satisfactory manner, from 2 to 2½ pails of water should be sprinkled over each cask of lime as it is emptied upon the pile, and finally the whole mass should be very thoroughly covered with soil. In a few days practically all of the lime will be in a fine condition suitable for spreading. In loading it into the spreader care should be taken to first remove the soil so as to avoid its clogging the machine. If the lime spreader itself is not fitted with a screen, the lime should first be carefully screened for the purpose of removing any hard lumps which may remain, due to imperfect slacking or burning. These lumps may be further slacked by themselves.

A practice preferred by many, and probably the most feasible one where a lime spreader is not to be had, is to place the burned lime in piles of from 35 to 40 pounds each at suitable intervals (heaps of this size 20 feet apart in each direction equals about 2 tons per acre), and cover the piles with moist earth. In a few days the lime is so thoroughly slacked that it can be spread directly with a shovel. Provided the soil is dry, from one fourth to half a pail of water (or in extreme cases even more) should be sprinkled over each pile immediately before it is covered with earth. In this case, as in all others where slacked lime is employed, it is important that it be harrowed into the soil immediately after spreading. In no case should it be exposed long to the air before harrowing, or it is liable to cake and form a sort of mortar, to such an extent that it is impossible to mix it as thoroughly with the soil as before.

FORMS OF LIME USED FOR AGRICULTURAL PURPOSES.

Caustic ("quick" or "burnt") lime obtained by burning oyster shells, limestone, etc., is the most economical form in which lime can be brought, in all cases where railway transportation is great or the material must be carted long distances. One hundred pounds of such lime usually contains about 95 pounds of actual lime. Sometimes burned lime contains considerable magnesia, a point which has already been considered.

According to Roberts, "when first removed from the kiln, lime weighs about 75 pounds to the heaped bushel; that from shells weighs less than that from limestone. A ton of limestone converted into caustic lime (CaO) weighs between 1,100 and 1,200 pounds; hence it is economy to burn the lime near where the stones are quarried, since it weighs but three-fifths as much as limestone. In slacking, lime takes up considerable quantities of water; hence a ton of slacked or hydrated lime contains really but three-fourths as much lime as a ton unslacked. A heaped bushel of unslacked lime makes 1½ bushels of slacked lime; therefore it should be transported before it is slacked. When caustic lime is exposed to the air for some time it absorbs moisture and carbonic acid from the atmosphere, and becomes air-slacked or carbonate of lime (CaCO3), or limestone. It is now in the form of a fine powder, much finer than ground limestone." Lime made from oyster shells and magnesian limestone weighs less per bushel than that made from the purer kinds of limestone.

Gypsum or land plaster is a combination of lime with sulphuric acid (oil of vitriol) and water. Upon heating, gypsum loses its water and is changed into plaster of paris or calcined plaster, which is used in making casts and for many other industrial purposes.

In case a soil is seriously deficient in lime, gypsum may act as a direct manure; usually, however, its beneficial effect upon soils is attributed to its indirect action in liberating potash, and possibly other elements, which were locked up in the soil in such combinations that plants could not make use of then. Gypsum may be helpful to a limited extent on

clayey soils by flocculating the fine particles, on account of which the soil is less likely to become "water-logged" and to cake and interfere with the operations of tillage. In the last mentioned respect water-slacked lime or that in the form of carbonate is said to be much more efficacious than gypsum, though as a liberator of potash gypsum is claimed to lead.

It is stated on good authority that, in the presence of decaying organic matter, gypsum may be changed into carbonate of lime. While this may be true under certain circumstances, in experiments at the Rhode Island Station on a soil exceptionally rich in humus and containing a moderate amount of plant residues which were undergoing decomposition, such a change did not result, if at all, to a practical extent. For this reason and on account of the fact that gypsum contains only about one-third as much lime as burned lime, and usually costs as much or more per ton, it can not take the place of the latter for most purposes where lime is applied to land.

For use in renovating "black alkali" (sodium carbonate) soils in the arid regions, gypsum, as already explained, performs a valuable function which can not be filled by any of the other forms of lime.

Chalk is a naturally occurring form of carbonate of lime which is exceptionally pure. It is quite soft, and is frequently referred to as marl.

Marl is a name which is applied to earthy deposits usually more or less friable in their character and containing carbonate of lime in quantities ranging usually from 5 to 95 pounds per 100 pounds of the material. It must be evident, therefore, that if one intends to make use of a given deposit of marl for the lime contained in it, he should first have a sample of it analyzed. If the materal will not effervesce upon the addition of vinegar, it probably contains but little carbonate of lime and may be of doubtful value. This test should precede, and not be substituted for, a careful chemical analysis.

On account of the varying chemical composition of marl, it must be obvious also that no definite rules as to the amounts which should be used in given cases can be stated. On a soil where one had reason to think a ton of burned lime should be applied per acre, about four tons of a marl containing from 20 to 25 per cent. of actual lime (calcium oxid) should be employed. If the marl is twice as rich the amount applied should be but two tons, etc.

Marls vary somewhat in their physical characteristics, depending upon the amounts and character of the earthy material associated with the carbonate of lime. If the marl is associated with clay it is exceptionally well adapted for use on sandy soils, since the clay and carbonate of lime both tend to make such soils more compact and retentive of manures and moisture. A marl containing sand would, on the other hand, be better suited to clayey soils. According to Heinrich, sand marl may be applied to the soil immediately, but clay marls sometimes contain injurious compounds of iron and sulphur, in which case it is not safe to use them until they have been composted for two or three years, or long enough to effect the decomposition of the iron compounds.

Some so-called marls contain considerable quantities of phosphoric acid and potash in such forms as to greatly enhance their fertilizing value.

Phosphate of lime is found as bone, guano, apatite, and in the form of the well-known South Carolina, Florida, and Tennessee phosphate rock. The better classes of phosphate rock contain but small quantities of carbonate of lime, while others contain large amounts. The latter are unfitted on this account for superphosphate manufacture. Both classes of phosphate when ground finely have been found to be effective upon acid soils, particular attention having been devoted to their employment on acid muck or peat soils. They not only seem to materially reduce the acid character of such soils, but after having been in contact with the soil for some time the assimilability of the phosphoric acid seems to become materially increased. The lower-grade phosphates containing considerable quantities of carbonate of lime are particularly effective upon acid soils.

In employing undissolved phosphate rock upon acid soils, good authorities recommend following the application of the phosphate at an interval of some months, or, if possible, a year, with a dressing of lime. This seems to be a reasonable recommendation in connec-

tion with certain plants which are indifferent to acid conditions.

Superphosphates, which are prepared by treating phosphate rock, bone, and boneblack with sulphuric acid, generally have about one-third of their lime combined with phosphoric acid and two-thirds with sulphuric acid. The lime combined with sulphuric acid is nothing more nor less than gypsum (land plaster). For this reason superphosphates frequently do not work as well on acid soil as ordinary undissolved phosphate rock or ground bone, and if, as is sometimes the case, a slight excess of sulphuric acid is present they may even exert an injurious action on soils devoid of carbonate of lime.

Basic Slag (Thomas Slag or Slag Meal) is a waste product obtained in the manufacture of steel. It contains relatively more lime than the ordinary high-grade phosphates, and the phosphoric acid in most cases (a few works have put an inferior product on the European market) is possessed of a high degree of assimilability. This product is as yet little known in this country, but if sold as cheaply as it might be it will doubtless prove of great value to our agriculture. It is an effective source of phosphoric acid for use upon all kinds of soils, and on account of its lime it is of special promise in the reclamation of exhausted acid soils, particularly such as are rich in organic matter, like many marsh or muck soils.

Unleached wood ashes contain about 35 pounds of actual lime (calcium oxid) in every hundred, three tons being, therefore, a little more than equivalent, in lime, to one ton of burned lime. They also contain from 5 to 7 per cent. of potash, 1 to 2 per cent. of phosphoric acid, and from 3 to 5 per cent. of magnesia. This latter ingredient, though usually ignored, is, when not present in too great proportions, of approximately as much value as lime on acid soil. Magnesia is sometimes lacking in soils. When applied to such soils it seems to have a direct manurial action.

Leached wood ashes contain usually less than 1 per cent. of potash and rather more lime than unleached ashes. Frequently they are sold in a wet condition, which of course lowers the quantity of actual lime present in a ton.

Limekiln ashes often contain approximately 40 per cent. of lime, and when wood is employed in the burning instead of coal they sometimes contain 2 per cent. or more of potash.

Finely ground limestone and oyster shells can be used to advantage, if obtainable, but they are not as efficacious as after burning, for the reason that they are not so active chemically, nor can they be reduced to so fine a state before burning as afterward.

Dye-house lime usually contains only a small percentage of lime, and if moist can not be transported long distances at a profit. A rule that applies well to this and all other waste products of a similar character is not to use them until they have been subjected to chemical analysis, for by changes in processes of manufacture their value may be materially influenced and substances injurious to vegetation may have found access to them.

Gas-house lime.—It is never safe to use this substance until it has first been allowed to weather for several months. On acid soils lime in this form is less effective than that in form of burned lime, wood ashes, and limekiln ashes. Owing to recent changes in the process of gas manufacture, lime is less used than formerly.

Waste Lime from Beet-sugar Factories may be effectively applied to soils after it has been allowed to dry. It contains some potash, phosphoric acid, and nitrogen, which still further increases its value. If this material is applied to the soil in a wet condition, it tends to cake in the same manner as water-slacked lime does when not immediately worked into the soil. It is sometimes put in piles by itself and worked over every few weeks. It may also be dumped in the field during the winter in small piles, where it is allowed to remain until spring, when, after drying sufficiently, it may be spread and incorporated into the soil. According to Heinrich, this material contains: Water, 35 to 60 per cent.; nitrogen, 0.1 to 0.4; potash, 0.1 to 0.3; phosphoric, 0.5 to 1.5, and lime 15 to 30 per cent. It is evident that this waste material in its moist condition could not be transported to any considerable distance at a profit, and in this country, where labor is such an important item, it would not pay to shovel it over in order to get it into condition to use.

Waste lime from soda-ash works us-

ually contains considerable water, and can for this reason only be employed to advantage where the cost of transportation is small. If some economical means of drying it could be devised, the range of distance to which it could be profitably shipped would be much increased.

From the preceding statements regarding the different forms of lime used for agricultural purposes it is evident that it is impossoble to state definitely for all locations and conditions which form is most economical to employ. The character of the soil and of the crop to be grown, as well as the market prices prevailing, must be taken into account, as well as the form of lime. Caustic or quicklime is the most concentrated form, and consequently the most economical to handle. Its caustic properties, however, render it more vigorous in its action than the milder sulphate (gypsum) or carbonates (limestone, chalk, wood ashes, marl, etc.), and thus better suited for application to soils which are rich in organic matter than to poor soils deficient in this substance. For the same reason, however, it is especially suited to correcting acidity in sour soils. There may be special reasons in particular cases, however, why some of the other forms of lime are prefrable to quicklime. Gypsum has been used to a considerable extent with very satisfactory results. On account of its peculiar composition it has been found especially valuable for neutralizing sodium carbonate (black alkali) in alkali soils. Wood ashes are extensively used in some localities, in many cases as much for the lime as for the potash which they contain. It is very doubtful, however, whether it would not be more economical, at the present prices of wood ashes and caustic lime, to employ the latter in the majority of cases, supplementing the lime with potash salts and other fertilizing materials if the latter are required by the soil. The item of transportation is also decidedly in favor of the use of lime and fertilizer chemicals as substitutes for ashes.

SUMMARY.

The use of lime as a soil improver is very ancient, and its value for this purpose is generally recognized. Its action as a fertilizer is both direct and indirect.

There are many soils in which lime is deficient, notably in soils derived from granite, mica schist, and sandstone formations. On such soils lime is of direct value in supplying a necessary element of plant food.

The indirect value of lime is perhaps more important than its direct action, because probably the majority of cultivated soils contain sufficient lime to meet the direct demands of plants. Lime is of indirect value in unlocking the unavailable potash, phosphoric acid, and nitrogen in the soil.

Lime exerts a decided influence on the mechanical condition of soils, rendering heavy compact soils looser in texture and tending to bind particles of loose leachy soils.

Lime is also beneficial in furnishing conditions in the soil favorable to the activity of the micro-organisms which convert the nitrogen of organic matter into nitrates which are readily assimilated by plants, which decompose organic matter, and which assist leguminous plants to assimilate the free nitrogen of the air.

One form of lime, gypsum, has been shown to be a most effective corrective of black alkali, found in some of the soils of the arid portions of the United States.

Thte continued use of lime unaccompanied by other fertilizers may prove injurious, especially on poor soils, since it converts the insoluble nitrogen, potash, and phosphoric acid compounds of the soil into forms which are rapidly taken up by plants or washed out in the drainage, and thus hastens the exhaustion of the supply of these substances in the soil. As the German adage states, "The use of lime without manure makes both farm and farmer poor." If the soil is not abundantly supplied with organic matter, its retentive power for water and fertilizers may be seriously reduced on acciunt of the destruction of the organic matter by the action of too much lime. Soils are sometimes injured by applications of impure forms of lime, which harden like cement in the soil, or of those which contain an excessive amount of magnesia.

It has been shown that even many up-

land and naturaly well-drained soils apparently in good condition otherwise are so sour (acid) that most plants will not thrive on them. The application of caustic lime is the most economical and effective means of correcting this condition. According to experiments made by the Rhode Island Experiment Station on acid soils in that State, the plants tested may be classified with regard to their behavior toward lime as follows: Plants benefited by liming—spinach, lettuce, beets (all kinds), gumbo (okra), salsify (vegetable oyster), celery, onion, parsnip, cauliflower, cucumber, eggplant, cantaloupe, asparagus, kohl-rabi, cabbage, dandelion, Swedish turnip, pepper, pea, peanut, martynia, tobacco, sorghum, alfalfa, clover, barley, wheat, oats, timothy, and Kentucky blue grass; plants injured by liming—serradella, watermelon, blue lupine, and common sorrel (Rumex acetosella); plants indifferent to liming—Indian corn, common millet, Hungarian, golden millet, rye, potatoes, carrots, Rhode Island bent (grass), and redtop (grass.)

Lime may be applied in a variety of forms, among which are caustic, or burnt lime, or quicklime, which should contain at least 90 per cent. of actual lime (CaO) and is the most concentrated form of this material; gypsum, or land plaster, in which the lime is in the form of the mild sulphate; ground limestone and chalk, in which the lime is in the form of the mild carbonate; different kinds of marl, containing varying proportions of sand and clay and from 5 to 95 per cent. of carbonate of lime; wood ashes, which contain from 30 to 35 per cent. of lime in the form of carbonate; limekiln ashes, containing about 40 per cent. of lime; and waste lime from gas houses, sugar-beet factories, etc., the composition of which varies with the process of manufacture.

It is impossible to state definitely for all locations and conditions what form of lime is cheapest to use. Caustic, or quicklime, is the most concentrated form and consequently the most economical to handle. On account of its caustic properties it is more vigorous in its action than the milder sulphate (gpsum) or carbonates (limestone, chalk, wood ashes, marl, etc.). There may be special reasons, however, why some of the latter forms may be preferable. For instance, gypsum, on account of its peculiar composition, has been found to be a specially valuable corrective of black alkali.

The frequency with which liming should be practiced depends, among other things, upon the character of the soil and the rate of application, the number of years involved in the rotation practiced, the plants grown and their order of succession. As a general rule, it may be stated that from one-half to 1½ tons of lime per acre every five or six years is sufficient. Applications of two or three tons may, however, be advisable in case of very acid soils which are to be seeded down and to remain in grass for several years. The practice of applying small amounts of lime at somewhat frequent intervals is being generally accepted as preferable to the use of large amounts at rare intervals.

Lime in the form of carbonate of lime, as in marl, wood ashes, etc., can usually be applied with safety in the spring or at any other season of the year, but autumn is always the safest time to apply caustic or slacked lime. It is generally considered best to apply the lime to the soil immediately after plowing and harrow in thoroughly. Lime which is already slacked may be spread upon the soil directly from wagons or carts, or dumped into heaps and then spread with a shovel, although the most satisfactory plan in such cases is to use a lime spreader or ordinary grain drill with fertilizer attachment. Where a lime spreader or similar implement is not available the burnt lime may be placed on the soil in piles of from 40 to 50 pounds each, covered with moist earth, and allowed to slack before being spread with a shovel. Marls frequently contain injurious compounds and should therefore be allowed to weather for some time in the field before being incorporated with the soil. The same is true of gas-house lime, which is impregnated with sulphur compounds which are injurious to plants.

In conclusion it may be said, ascertain first whether lime is needed. If it is, apply it judiciously, and never depend upon lime alone to maintain the fertility of the soil, for all of the ingredients which plants need must be present in the soil to insure the profitable production of crops.

THE FARMERS' INTEREST IN GOOD SEED

(EXTRACTS FROM BULLETIN)

—BY—

A. J. PIETERS

In Charge of Pure Seed Investigations

Division of Botany

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INTRODUCTION.

The successful farmer of to-day is on the alert for improved methods and machinery, better varieties, and the prevention of unnecessary waste. While many of the dangers to crops can not be avoided, it may be possible by care and foresight to keep clear of some which are commonly unnoticed. One of the controllable factors, and the one which is perhaps most often neglected, is the seed.

POOR SEEDS AND MEANS OF PROTECTION FROM THEM.

For the last three or four years there has been a constantly increasing outcry against the seeds sold by unscrupulous dealers, and some demand for legislation. A few States have passed, or have attempted to pass, laws regulating the trade in seeds. This serves to show that in some places the farmers are alive to the injury done by the sale of foul or poor seeds, and are searching for a remedy. As yet, however, there is no indication that the mass of farmers realize the extent of the evil or see clearly how the sale of poor seed affects them personally. That there are many frauds in the seed trade no good seedsman will deny, but much of the complaint about poor seed is due to the fact that dealers themselves are ignorant of the quality of the seeds they sell. The solution of the difficulty lies with the consumers; if they will demand a statement of quality, and purchase only from firms willing and able to give a reliable statement, and if they will pay what good seed is worth, they will get good seed; if they continue to buy haphazard, they must take their chances.

SEED TESTING, AND THE FEATURES OF POOR SEED.

The purpose of this bulletin is, besides calling attention to this question in a general way, to give the results of many tests made in the seed laboratory of the department, and to make suggestions tending toward the betterment of agricultural seeds. Except wheat, corn and oats, the seeds of grasses and clovers are most largely used by farmers, and these are also the most frequently impure, adulterated or dead. It is true that much poor vegetable seed is sold, but in this case the question of genuineness of variety is of chief importance, and to determine this before the seed is planted is impossible. But with grasses and clovers the case is different; the exact value of the seed can be determined long before planting, and there is no good reason why this should not be done.

Three charges may be preferred against poor seed, any one of which ought to be sufficient to condemn it, while usually all three can be proved.

(1) The seed will fail to grow, or if it grows will give an uneven stand.

(2) In case of grass or clover seed, it

Without Good Seed

NO GROWER can raise a good crop, for that reason he should be careful in selecting his seedsman.

The use of POOR SEED causes a loss of millions of dollars annually, directly or indirectly to farmers.

LOW PRICED seed is often POOR SEED and is then far more expensive than high priced GOOD SEED. Dirty Seed endangers the farm by introducing Weed Seed.

"A farmer who paid $3.50 for a bushel of clover seed which tho weighing 60 pounds was found to contain only 27¾ pounds of good seed, was in reality paying at the rate of $7.57 per bushel for his seed" Pure and Germinable seed is what the farmer wants. Poor seed costs more than it is worth.

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We have a thorough knowledge of the seed business. We send seeds all over Canada.

——Write For Our Catalogue——

Robert Evans Seed Co.
LIMITED

Hamilton, - - Ontario.

bring an entirely new weed to the farm.

(3) Poor seed costs more than it is worth.

RELATION BETWEEN QUALITY OF SEED AND AMOUNT TO SOW PER ACRE.

The amount of seed to sow per acre is regulated by more or less well-defined rules, based upon general experience and varying somewhat locally. Thus, it is said that 3 bushels per acre should be planted of redtop, orchard grass and English rye grass; onehalf to 1 bushel of timothy; and 10 to 15 pounds of clover. These rules, however, do not take into consideration the quality of the seed used. Assuming, for example that 3 bushels of first quality seed is meant, then an increased amount should be sown when an inferior seed is used The standard weight for orchard grass is 14 pounds per bushel, and of this, according to our tests, 8 9-10 pounds consists of pure seed that will grow, the remainder being chaff, dead seeds and weed seeds. If now the seed purchased has a lower germination, say, 50 per cent. instead of 80 per cent., then there will be only a little more than 5 1-2 pounds of pure and good seed in every bushel. Again, if the amount of chaff is greater, there may be only a little more than 3 1-2 pounds of pure and good seed in every bushel. Three bushels of standard orchard grass seed, weighing 14 pounds to the bushel, contain 25 4-5 pounds of good seed; therefore if a similar stand is desired from seed of the same weight but lower germination, say 50 per cent., as above, nearly 5 bushels per acre must be sown, while of seed weighing 12 pounds per bushel and germinating 50 per cent., 6 1-4 bushels will be needed. On the other hand, if high-grade seed, weighing 16 3-4 pounds per bushel, and germinating 90 per cent., is used, there will be over 14 pounds of good seed to the bushel, and less than 1 3-4 bushels need be used. It is clear from this that the little knowledge one gets of a sample of seed by passing a handful through his fingers is not a sufficient basis for a correct judgment of the amount to sow. A uniform stand under these conditions is secured only by chance. Seed may fail to come up if thus carelessly selected, though every care has been taken with the preparation of the land. In this case failure, with consequent loss of the cost of seed, of labor, and of the use of the land, could have been avoided by testing for germination before planting.

WEED SEEDS SOWN ON THE FARM.

One of the ways in which weed seeds are most widely distributed is by being sown along with agricultural seeds. The number of weed seeds sown every year in this way is astonishing. What makes the matter worse is that they are usually sown with grass or clover, crops that are not cultivated, and in which, accordingly, the weeds remain unmolested long enough to get a good foothold. Some samples of seed contain such a small amount that they would be considered practically pure, but even in these the number of weed seeds in a pound is surprisingly large. In one sample that contained in all only one-fifth of 1 per cent. of spurious seeds the number of weed seeds per pound averaged about 990. In a bushel of 60 pounds there were, therefore, more than 59,000 weed seeds. A sample containing four-fifths of 1 per cent. of spurious seeds had about 3,000 weed seeds per pound, while in another sample in which 2.5 per cent. was spurious seed, there were more than 27,600 weed seeds in every pound. If 15 pounds were sown to the acre, the farmer distributed about 414,000 seeds of weeds, all of which had an equal chance with the crops among which they grew. The first two samples mentioned would be regarded everywhere as good seed, and the last would not generally be considered very bad. Sometimes, however, clover-seed tailings are used on the farm, while the cleaned seed goes to market. Such tailings have been found to contain nearly 272,500 weed seeds per pound. A sample of clover seed offered on the Chicago market about two years ago for 2 cents per pound contained about 338,300 weed seeds per pound, or more than 20,000,000 per bushel. While the presence of weeds in cultivated fields may not be a wholly unmixed evil soil, their intrusion into meadows and since they compel the stirring of the

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The best investment I ever made was when I bought a

MELOTTE CREAM SEPARATOR

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But when you get a Separator be sure it is a

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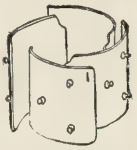

Other features of the "**MELOTTE**" are **THE FRICTIONLESS SELF-BALANCING BOWL,** the simplicity of which as contrasted with the clumsy arrangement of other Cream Separators is alone sufficient to account for the pre-eminence of the "**MELOTTE**" and **THE BRAKE** which is necessitated by the easy-running of the Machine, due to its excellent mechanical construction, and oiling arrangements.

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pastures has not even this advantage. Here they crowd out better plants, thus decreasing the value of the hay, and are at all times difficult to control.

LOW-PRICED SEEDS MAY BE EXPENSIVE.

While it is difficult to estimate the money loss chargeable to poor seed on account of extra labor, loss of the use of land, and the introduction of weed seeds, it is easy to determine the exact loss due to the quality of the seed itself, reckoned on the increased price for the seeds that actually come up and grow.

A sample of seed may contain:

(1) Pure and germinable seed, that is, seed that will grow and produce the kind of plants wanted.

(2) Chaff, sticks, and dirt.

(3) Dead seeds of the kind purchased.

(4) Weed seeds, and field seeds other than those wanted.

Of these the pure and good seed only is of any value, the remainder being either useless or positively harmful. The value of the sample to the farmer will depend, then, upon the amount of pure and germinable seed present. It is for this that the farmer pays, and whether the seed is cheap or expensive, depends not solely upon whether it is low or high-priced, but upon how much he pays per pound of good seed. The term "actual or net value" is used in seed-testing establishments to indicate the proportion of seed that is both pure and germinable. For example, if a sample of clover seed has 98 per cent. of pure seed and 90 per cent. of this will germinate, then the proportion of good clover seed in the entire sample is 90 per cent. of 98 per cent., or 88.2 per cent. This represents the net value of the seed, and in a scale of 100 the sample is said to have a net value of 88.2. The standard weight of a bushel of red clover is 60 pounds, and a sample having a net value of 88.2 will contain 52.9 pounds of good seed. The net value of the seed sold on the market varies widely, and there is no constant relation between cost and value.

RESULTS OF SOME TESTS.

Red Clover, Trifolium pratense.

Five of the samples of red clover in the following table were fairly good seed, but the price was not always proportionate to the real value. Samples 2 and 7, though inferior seed, were really the most expensive, while for sample 6 less was paid per pound of good seed than for any of the others. Most of these samples were purchased in the same place, and two of them, Nos. 1 and 3, from the same dealer. They illustrate how little local dealers regulate prices according to the real value of the seed.

COMPARISON OF MARKET PRICE OF CLOVER SEED WITH PRICE ACTUALLY PAID FOR THE GOOD SEED.

Sample number.	Market price per bushel (60 pounds).	Per cent. of good seed.	Number pounds good seed per bushel.	Price paid per bushel of good seed
1	$5.50	93	55 8	$5.88
2.....	5 25	76.2	45 72	6.90
3.....	5.00	92	55.2	5.40
4	4.75	93	55.8	5.10
5.....	4.75	80.1	48	5.94
6	4.00	87.3	52.38	4.59
7.....	3.50	46.2	27.72	7.56

In this table the cost of the seed has been reduced to cost per bushel of good seed. A consideration of the table shows that neither the highest nor the lowest priced sample was the cheapest. The lowest-priced lot, No. 7, cost more per bushel of good seed than any other, while lot No. 6 was the best one to buy because it sold for the lowest price per bushel of good seed. If this lot had contained the seeds of injurious weeds that fact would have had to be taken into consideration when judging of its value. The presence of dodder, even in small amounts, should condemn any sample of clover or alfalfa, no matter how good it may otherwise be, and the presence of more than 1 per cent. of weed seeds will take far more than 1 per cent. from the value of the sample. The important point is that the value of clover seed should be judged, not by its price per bushel, but by its price per pound or bushel of pure and germinable seed.

HOW TO SECURE GOOD SEED.

Four Points Requiring Attention.

As has been said, the remedy lies with the consumer. All legitimate demands in trade are bound to be met, and if

Death to Flies

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You should use Eureka Fly Killer for humane motives if guarantee of gain does not influence you : : : : : Eureka Fly Killer is a sure preventive that Kills and Drives Away the worst of all Pests, the TEXAS BUFFALO AND HORN FLIES : : : : : :

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Oftentimes and for various reasons lice infest poultry and poultry houses. The result is less profit because of loss in weight, and less eggs because hens will not lay when infested with lice. Eureka Fly Killer is the only preventive that has been offered that will remove these pests from poultry and poultry houses. Two applications are usually sufficient. Thus a very, very small expenditure of time and money for Eureka Fly Killer saves many dollars to the poultry keeper.

Healthy cattle, amiable, gentle, and sleek horses, strong and vigorous sheep and lambs, busy hens, plenty of eggs and growing chicks, absolutely guaranteed by the use of EUREKA FLY KILLER.

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purchasers will intelligently and persistently demand good seeds they will get them. When trying to get good seeds four rules should be observed: Buy from reliable firms; avoid the cheap grades; demand a statement of quality in percentage; test the seed.

RELIABLE SEEDSMEN AND THE DEMAND FOR CHEAP SEED.

It is hardly necessary to insist that some seed dealers are more reliable than others. There are plenty of honest seedsmen in the United States, and these aim to treat a customer fairly, but many of these firms have not an adequate knowledge of grass and forage plant seeds, and are almost as liable to error as the purchaser himself. A firm that can be depended upon in the sale of grasses and clovers must not only be honest, but must have a special knowledge of the seeds it sells. Such firms usually offer their customers a fancy article and urge them to buy it in preference to the cheaper grades, but the latter must be handled because of the demand for them.

At a meeting of seedsmen one of the number said that he had been advised to continue offering high-grade seeds, although the demand did not seem to justify it, and these grades were not profitable. The reason given to him was that it would help his reputation, and that so long as people were foolish enough to buy low grades and tailings, his profits would come from the sale of these low grades. It is true that seedsmen find less profit in the high grades than they do in the cheaper ones, and no dealer can afford to confine his trade to the former. He must keep what his customers demand. But how much more profitable for the customer to buy the high-grade seeds.

NEED OF STATEMENT OF PERCENTAGE OF GOOD SEEDS.

When the purchaser personally knows his dealer to be both honest and capable he may safely buy the high-grade seed offered. In most cases, however, these ideal conditions do not exist, and seeds are bought from dealers of whom little is known beyond their financial standing. It is in these cases—and they make up the bulk of the trade—that the percentage statement and subsequent test are useful.

In Europe many of the best firms have guaranty relations with seed-testing stations. They guarantee their seeds after these have been tested by the station, and the buyer has the privilege of having seeds tested by the station free of cost. If the seeds fall short of the guaranty, the matter is settled according to the terms of the contract. There seems to be no reason why a guaranty should not be given in this country. Fertilizer laws indicate a concession that the farmer has a right to know exactly what he is buying. An analysis of seed is as easily made as one of fertilizers, and why should not the purchaser demand a guaranteed analysis of the seed he buys? It would, of course, be unreasonable to expect the same guaranty for all grades and prices, and some years it might even be impossible to offer seeds of the highest grades. Conditions of place and season must control everywhere, but the purchaser should have a chance to know just what the particular lot he buys is worth. This end might also be attained by securing a statement, without guaranty, of the purity and germination of the seed offered.

While guaranteed seed is undoubtedly the safest, its extra cost may at first render it unpopular and would greatly limit its use, even if a guaranty could be obtained. However, by substituting a percentage statement of quality for the present vague and unreliable grade names, much would be done to protect the buyer and to expose those dealers who habitually sell inferior goods at slightly lower prices to catch the unwary.

The grade names in use at present generally mean nothing to the farmer, and are quite misleading. If, instead of "fair," "prime," "choice," or "fancy," clover-seed quotations were to read "pure and germinable seed, 60 per cent.," "70 per cent.," "80 per cent.," "90 per cent.," or whatever percentage of good seed of the kind named might be present, the purchaser could tell at once the relative value of every sample. These percentages could be based on tests made either by the seedsman or by the experiment stations.

Government Approval of the Spramotor

The following extracts will show how the Spramotor is regarded by some of the leading Government officials. They have purchased the Spramotor only after making elaborate and exhaustive tests. These facts should mean something to you, Profit by the experience of others :—

ONTARIO. This is to certify that at the contest of Spraying apparatus held at Grimsby, under the auspices of the Board of Control of the Fruit Experimental Station of Ontario, in which there were eleven contestants, the Spramotor Company of London, Ont., WAS AWARDED FIRST PLACE.

H. L. HUTT and M. PETIT, Judges.

DEPARTMENT OF AGRICULTURE, TORONTO.

I have great pleasure in stating that the Spramotor ordered from your Company has given entire satisfaction.

JOHN DRYDEN, Minister of Agriculture.

The London Spramotor Combination is the only reliable pump I know for applying mechanical mixtures.

GEORGE E. FISHER,
Chief Inspector of San Jose Scale Investigation.

DOMINION OF CANADA.

DEPARTMENT OF AGRICULTURE, OTTAWA.

I used your Spramotor in my apple orchard of 1,600 trees. It is easy to handle and perfect in action. I never had my orchard looking cleaner than at the end of last season.

GEORGE JOHNSON,

CATTLE QUARANTINE STATION, QUEBEC.

I have much pleasure to inform you that the outfit bought from you for disinfecting is giving us the greatest satisfaction.

J. A. COUTURE, D.V.S., Inspector.

RUSSIA. I have the honor to apply to you for five Spramotor machines of the same size, No. 1D, and one Spramotor Knapsack. I remain, gentlemen, your obedient servant,

NICHOLAS KRUKOFF,
Representative of the Ministry of Agriculture, Russia.

Write them a postal card with your address to

The Spramotor Co., London, Ont.

And they will send you a complete treatise on Spraying and full particulars regarding their Spraying Machine.

Making these tests and keeping track of tested stock naturally involves some trouble, and to this many seedsmen object, but they should bear in mind that the preparation of land, purchase of seed and loss of time involve much trouble and expense to the farmer, and he has a right to all protection that does not work injustice to the seedsmen. The demand for a percentage statement of quality does not involve such injustice, because the farmer only asks for definite information of the utmost importance to him, about an article on which such information is readily obtainable by the seller.

THE NONWARRANTY CLAUSE AND CO-OPERATIVE BUYING.

It will, of course, be difficult to induce the members of the seed trade to abandon the time-honored nonwarranty clause, which exempts the dealer from all responsibility as to the character of the seeds sold. Whatever may be said as to the necessity of this clause in the sale of vegetable seeds, when grass and forage plant seeds are sold in quantity, the purchaser has the right to know about the quality. The practical question is how to get the seedsmen to give a percentage statement in the absence of special laws requiring it. It is probable that the general demand of farmers, if determinedly and persistently made, will meet with success. The seedsman cannot afford to ignore the just demands of his patrons, especially if the refusal means the loss of valuable orders. The pressure will be greater if all the seed used in a community is purchased through co-operation in one order. This method is now followed with success when it is desired to get lower prices than can be given on small orders, and might equally well be adopted when the object is to get seeds of known quality. It must not be overlooked, however, that tested seeds of high quality will cost more than the common grades. Even if the quality is the same, the work of testing involves some expense, and a purchaser should be willing to pay a shade more for seed when he is assured of the quality. Of course, unscrupulous dealers could still sell seeds under false pretences, but it would be more difficult to shirk the responsibility; and a determination not to patronize a dealer who is persistently guilty of misrepresentation would soon make his position untenable.

TESTING OF GUARANTEED SEEDS IMPORTANT.

It has already been shown that the best seed to buy is that which is guaranteed free from injurious weed seeds, and of which the price per pound of pure and perminable seed is the lowest. If the purchaser has any doubts about the seedman's statement, or feels that he would like to make sure of the quality of his seed before planting, he should send a sample to a seed-testing station. Whether seed is guaranteed or not, the most important thing is to have it tested. The risk involved in planting untested seeds is too great, especially when a considerable quantity is used.

TWO KINDS OF TEST NECESSARY TO THOROUGHNESS.

A complete test of a sample of seed consists of a purity test and a germination test. If the purchaser is satisfied about the purity of his seed, as he may readily be in the case of wheat, oats or corn, a germination test should still be made. It is true that often much may be known of the vitality of seed from its color; for example, bright-colored crimson clover seed is pretty sure to germinate well, and dull-looking seed to germinate poorly. But in many cases no visible difference exists, and it is always safest to make the germination test. All seeds, except grasses, can be tested for germination at home, as well as at a station, and farmers are urged to make these tests.

PRACTICAL DETAILS OF SEED TESTING.

A simple germinating apparatus can be made from two ordinary plates and a piece of flannel cloth. Fold the cloth and lay it in one plate, placing the seeds between folds of the cloth, which should be moist, but not dripping. Cover the whole with another plate, inverted, and stand in a warm place. If the test is made during cold weather, care must be taken to stand the plates where the

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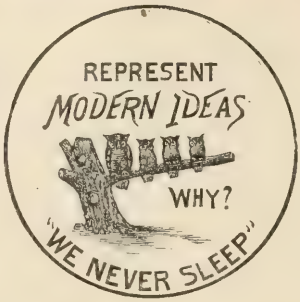

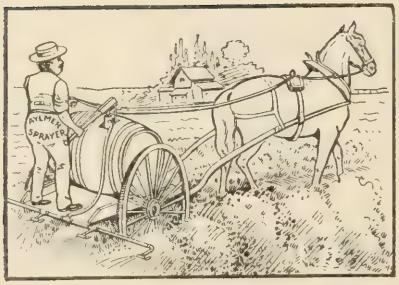

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ALYMER, ONTARIO

temperature will not fall much below 50 degrees Fahrenheit at night, and will be about 65 degrees or 70 degrees during the daytime.

The seeds that have sprouted should be removed every day and the number recorded. When the test is completed the number of seeds sprouted can be compared with the number put in the test, and the percentage of germination determined. Clover seeds, cereals and timothy should be tested for about ten days, while other grass seeds need fourteen to thirty days.

OPPORTUNITIES FOR TESTING BY EXPERTS.

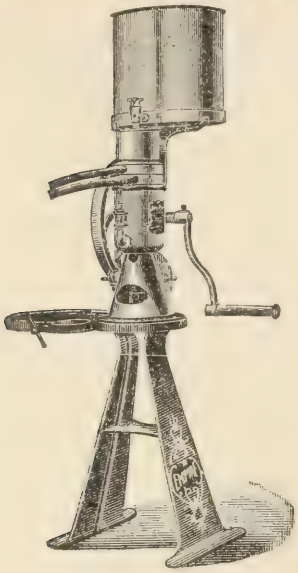
Purity tests and germination tests of grasses can be best made by experts. Many of the State experiment stations are prepared to test seeds, and the United States Department of Agriculture has a well-equipped laboratory for the same purpose. At this laboratory tests will be made free of charge, up to the limit of the facilities afforded, for all persons complying with the conditions. Full information concerning the seed is all that is asked. The name of the seller and the price must be given in every case, and it is desirable to know the year and place of growth, as well as any guaranty or claim of grade that may have been made for the seed. When this information accompanies the sample a report may be expected promptly.

IMPORTANCE OF CARE IN DRAWING THE SAMPLE.

Great care should be exercised in drawing the sample, as the value of the test depends largely upon the exactness with which this has been done. We often get samples containing about two thimblefuls of seeds. Such samples are worthless for testing; the quantity should never be less than one ounce of the smallest seeds and four to eight ounces of the larger kinds. The sample must fairly represent the entire bulk, and to do this it must be drawn from different parts of the mass. When a bag of seed, especially grass seed, has been sent some distance, and has been shaken up by the jolting of the cars or the farm waggon when being brought from the freight depot to the barn, the lighter seed and chaff tends to gather on top, while the heavier seed settles to the bottom of the bag. If a sample were taken from the top of such a bag it would not fairly represent the lot; neither would one taken from the bottom. To get a fair sample the seed should be emptied upon a smooth floor and thoroughly mixed with a shovel. Small portions should then be taken from different parts of the heap, and these together make the sample. In case the quantity of seed bought is small it may be poured into a pail or other receptacle and small portions taken from time to time, as the seed is poured out. When guaranteed seed is sent for test, especial care should be taken and a disinterested witness be present to sign the blanks that will be forwarded from the station.

It cannot be too emphatically stated that the value of the test depends largely upon the fidelity with which the sample represents the whole lot of seed. No claim for damages could possibly be based on a test if it could be shown that the sample tested did not fairly represent the lot. With a carefully-drawn sample, however, the station should be able to report the exact value of the seed and expose any adulteration or other fraudulent practices. The purchaser can then decide for himself whether or not the firm from whom the seed was bought is dealing fairly.

Dirty seed endangers the farm by introducing weed seeds. Low-priced seed is often poor seed, and it is then far more expensive than a high-priced good seed. The price of seed per pound or bushel is no accurate measure of its value; the true value is found by testing the sample and thus determining the per cent. of good seed present. A statement of the percentages of purity and germination should be demanded whenever seeds are bought in quantity. As already stated, the Department of Agriculture is ready to test seeds and will report promptly on their real value.



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Butter Making on the Farm.

(Extracts from Bulletin)

—BY—

C. P. GOODRICH

Dairy Instructor, Farmers' Institute Department,
University of Wisconsin.

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INTRODUCTION.

As a matter of course, everyone who keeps cows for the purpose of making butter is desirous of making an article that will bring the best price possible, and of making the greatest amount of butter possible out of the milk produced. When the milk is delivered to a creamery it is usually manufactured by those who have been well instructed in the art of butter-making, and the result is that, as a rule, a fairly good article is made. Besides this, the creamery is equipped with appliances which enable its butter-maker to obtain very nearly all the butter contained in the milk; and by his knowledge of what the general butter market demands, he is able to produce an article which is readily sold.

But the case is different with those who make butter on farms, where by far the greater part of the butter in this country is made. While on some farms excellent work is done and a choice article is made, which brings a fancy price, yet through ignorance of correct methods of manufacture and of the demands of the market, and, in many instances, through careless and slovenly habits, the great bulk of farm-made butter fails to bring the price it should, entailing a loss on the farmers of the country which is enormous in the aggregate. It is for the benefit of the latter class that this article is written, with the hope that some suggestions may be given, and some ideas advanced, which will serve to improve the methods of the dairyman and increase his profits.

GOOD MILK.

To make good butter, one must have good milk, and this comes only from healthy cows, fed on good, sweet pasture or on good, sweet grain and other forage, and which have pure water to drink and pure air to breathe. Certain obnoxious weeds—leeks, wild onions, rag-weed and others—give the milk and the butter made from it a decidedly bad flavor; so also does damaged, rotten silage, moldy corn fodder or hay, and musty, damaged grain. Impure water has its effect, both on the health of the animals and on the quality of the milk. In many pastures are seen small pools, in which the cows stand during the heat of the day to rid themselves of flies. The water in these becomes filthy, and is kept stirred up by the movements of the cattle, and where, as is often the case, it is the only water obtainable, the cows are compelled to drink it. This can usually be avoided by fencing the pond and keeping the cattle out. If this water is needed for the cattle it can be drawn out by a pipe laid on the lower side into a trough, from which the cows can drink.

In a close, crowded and illy-ventilated stable, where there is too little air space for each animal, the air becomes foul from the exhalations, and this affects the milk as well as the health of the animals. The remedy in this case is to provide more room for the stock and better ventilation.

The stable should be kept as clean as possible, and the cows well bedded and clean. The utmost cleanliness should

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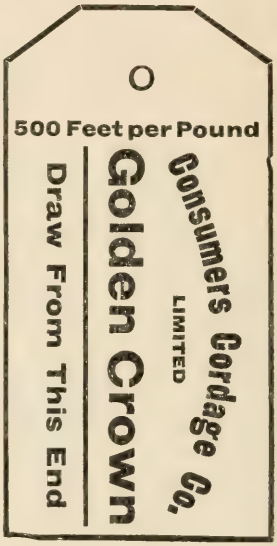

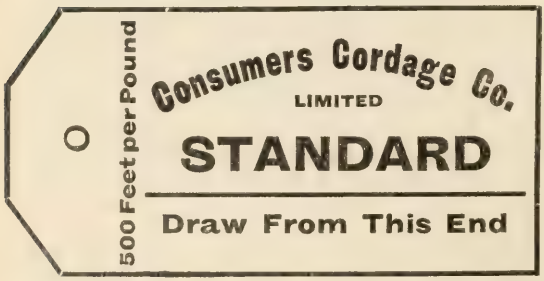

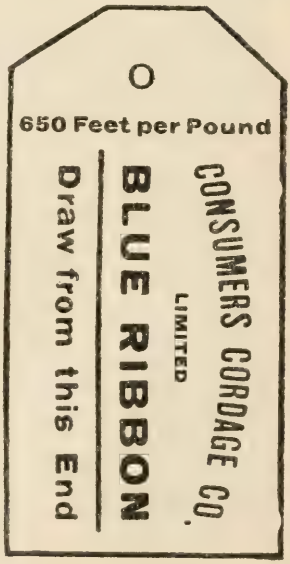

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be observed in milking. All dirt should be brushed from the cow before beginning to milk, and it is best to dampen the udder and flank of the cow, so as to prevent the dust and fine dirt from falling into the milk. The milk should be strained immediately after milking, and not allowed to stand in the cow stable any longer than is absolutely necessary.

A good strainer is indispensable, and one of cloth is much better than one of wire gauze. Milk pails should always be made of tin, and the seams should be soldered smooth, so that there will be no places for the dirt to lodge where it will be difficult to remove. They, as well as all other dairy utensils, should be thoroughly cleaned every time after using. Tin articles should be washed first in cool, then in hot water, and after that thoroughly scalded with boiling water or steam. They should then be dried in fresh air, and, if possible, in the sunlight. They will not need wiping after the scalding, as the heat from the boiling water will cause them to dry quickly. In washing them, if hot water is used first, it will cook the milk onto the tin and make it difficult to remove.

In cleaning the butter-bowl, ladle, worker, churn and any other wooden utensil, they should be first washed with hot water, then scalded with boiling water or steam. They should be aired, but it will not do to have them much exposed to the sun, as that will cause warping and cracking.

CREAMING THE MILK.

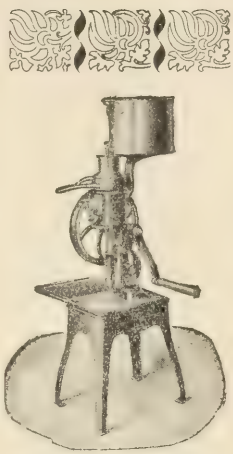
When good, clean milk has been secured, the next operation is to separate the cream from the body of the milk. The old way, practiced by our mothers and our grandmothers, was to set the milk in shallow pans, with the milk not more than two or three inches deep. The writer of this has been through all the successive stages of dairy methods. First, we used to set our milk in common ten-quart tin pans on shelves; then we had it arranged so that in hot weather cold water flowed around the pans to keep the milk cool. After that, large shallow pans were used, each one large enough to hold a single milking of the entire herd of 25 or 30 cows. Under these pans were water channels, through which in warm weather cold water was run, and in cold weather warm water, to regulate the temperature of the milk. Then the deep cold-setting was used in both "shot-gun" cans and Cooley cans, and finally, for the past five years, the farm separator has been used.

It is undoubtedly true that by the old method of shallow setting as good a quality of butter was made, and can yet be made, as is produced by any other method, but it has its drawbacks. Uniformly good results can not be obtained, for the reason that the milk, being spread out in a thin sheet, is exposed to the air, so that it is readily affected by atmospheric changes. Whatever may be the reason, very bad effects often follow an electric storm or thunder shower. The shallow pans make more work than other methods; the creaming is not so thorough as with the separator, and, therefore, the quantity of butter is less.

As there are many persons who think they are so situated as to make any other method impracticable, or who have such a deep-seated prejudice in favor of the old way that they cannot be induced to change, it is thought advisable to give directions as to the best manner of proceeding, as determined by the result of long years of practical experience, although the method itself is not recommended.

Milk should be set as soon as possible after being drawn from the cow, whether shallow or deep setting is used. With open setting it must be in a room where the air is pure. A pantry with a door opening into the kitchen is a bad place. The odor from cooking vegetables and meat will surely injure the butter. Many make butter in a cellar because it is cool, but it is apt to impart a musty, moldy smell to the butter. A cellar may be good and cool, and yet be so ventilated as to have pure air; then it is all right for butter-making. To get the best results with shallow setting, the temperature of the milk should not go much above 60 degrees F. At that temperature it can usually stand about thirty-six hours. The time to skim is when the milk has soured just enough to be a little thick at the bottom of the pans, and to thick-

An Inside Pointer



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en the cream. The cream can not be skimmed off when it is thin and sweet without loss. No milk should be taken with the cream. Cream with milk in it sours much more rapidly than cream with no milk in it. This cream will be very rich and thick, and, although partially ripened when taken off, if kept at a temperature of 60 degrees or below, it will be all right if held two or three days before churning. Whenever a new skimming is put into the cream jar or can, the whole should be thoroughly stirred and mixed.

In the winter effective creaming may be had when the room in which the milk is set is very cool, even down near the freezing point. This is accomplished by heating the milk to above 100 degrees F. before setting. The cream will rise very rapidly while the temperature is falling. The warming can be repeated after twelve hours, if the milk is in small pans, by setting over a kettle of boiling water. If large pans are used, such as have been described, the heating is done by running hot water through the water channels beneath the milk. This practice of repeated heating and cooling makes very effective creaming, leaving but little butter-fat in the skim-milk, and the cream is rich and thick.

DEEP COLD-SETTING.

With this method the milk is set in cans about 20 inches deep by 8 inches in diameter. It should be set in a tank of ice water as soon as possible after milking while the milk is yet warm. The most effective creaming is done when the temperature of the water is maintained at about 40 degrees F., though fairly good work is done when the water is even up to 50 degrees F., if it is allowed to get no higher. When there is a fountain or flowing well or running stream of water continually flowing into and out of the tank, so that the water is constantly being changed around the cans, the warm milk will be more rapidly cooled and the cream will rise more rapidly than if the water is at rest. For this reason cool springs, spring pools and spring houses are very satisfactory, even if the water is up to 53 degrees or 54 degrees F.; and deep stone jars or milk crocks may be used as well as deep tin cans. It is claimed that with this mode of setting all the cream that can be obtained will be up in ten or twelve hours. This may be so, though it is doubtful. It is better to let it stand twenty-four hours, for the reason that the cream will be thicker and richer at the end of that time, though it may not measure any more, or even as much, in depth as it would when set only twelve hours.

Setting the cans in cold air will not prove nearly as effective in raising the cream as setting them in cold water, even though the temperature of the surrounding air is near the freezing point.

With the jars, crocks, and the common "shot-gun" cans, as they are called, the skimming is done by dipping the cream from the top, but with the Cooley cans and many other creamers it is done by drawing the milk off from the bottom and leaving the cream. There is a strip of glass inserted in the side of most of these cans, so that the depth of the cream can be seen. With deep cold-setting the cream is always sweet and thin, and where the skimming is done from the top it requires a great deal of skill to dip the cream off without getting some of it mixed with the milk and lost. Much more cream and, consequently butter, is lost in this way than is even dreamed of by those who practice it. A conical or pointed dipper is the best kind of skimmer for this work. In using it insert the point of the skimmer in the middle of the can and press it down very gently till the cream slowly runs over into it. When it is filled carefully life it out and empty it; then put it into the can in the same place it was before—that is, in the middle—and repeat the operation till the cream is all off. This work should be done very carefully, so as not to create any commotion in the milk; and even with the best of care some of the cream will get mixed with the milk and lost. Much the best way is to skim by means of a faucet drawing off the milk rather slowly at the bottom, so as not to create currents in the milk, and leave about one-half an inch of milk under the cream.

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By the use of the cream separator a much more perfect separation of the cream from the milk may be had than by any system of setting milk. This is shown by the increased amount of butter made when the separator is used, and also by the amount of butter-fat left in the milk after skimming, as shown by the Babcock milk test. It has been found that by no system of gravity creaming can all the butter-fat be recovered; and usually, under ordinary conditions, a large per cent. is lost; while with the separator very nearly all is recovered.

The writer has been engaged in the Farmers' Institute work in the State of Wisconsin, during each winter, for several years. At each meeting milk was tested with a Babcock tester, which was carried along for the purpose. Farmers were invited to bring in samples of milk to be tested, in order to show them the variation in value of different milks, and for the purpose of illustrating and explaining the working of the machine. They were especially urged to bring in samples of skim-milk—that which they thought had been thoroughly creamed—so that the audience might see what the loss was. For two years the writer preserved the report of these tests, and the average of all was eight-tenths of 1 per cent. for the skim-milk creamed by any gravity method. It varied from one-fourth of 1 per cent. to 1 6-10 per cent. This was in the winter, when there was no difficulty in having the milk cold enough. There is no doubt that in summer, during hot weather, the average loss is still greater. If the separating is done on the farm immediately after the milking, the skim-milk from the separator seldom tests more than one-tenth of 1 per cent., and frequently less than that.

From the result of these tests it seems impossible to escape the conclusion that the average loss, where the milk is set in pans, cans and crocks, is three-fourths of a pound of butter more to each 100 pounds of milk than where the separator is used. This means, with milk of average richness (3.5 per cent. of butter-fat), a loss of about 20 per cent of the total product of butter. A herd of cows ought to average, per cow, 5,000 pounds of milk each year, and would do so if made up of good animals and well managed; but even if they only averaged 3,000, the loss on one cow would be 22 1-2 pounds of butter, and on ten cows 225 pounds, which, at 20 cents a pound, would be $45 a year. It will be seen by this that the loss to the farmers, who cream their own milk by a gravity process, is enormous in the aggregate. How can any business man succeed and suffer such a percentage of loss? What would be thought of the man who would go on from year to year with a hole in his pocket, through which 20 cents would drop out and be lost every time he put a dollar into his pocket? Some men try to console themselves by saying, "It is not all lost; the calves and pigs get the butter." But this is poor consolation, for butter is dear feed, even when the price is the lowest. One cent's worth of oil-meal will do the calves and pigs as much good as a pound of butter. Besides this, the skim-milk from the separator, when it is run through and fed to them immediately after milking, while it is warm and new and sweet, is better feed for calves than skim-milk that is old and partially sour, even though it does contain one-quarter of the butter-fat originally in it. This can be attested by hundreds who are using farm separators.

The cost of hand separators is from $65 to $125 each, according to size and capacity. They will skim from 160 to 400 pounds an hour. Larger sizes, with greater capacity, are used in large dairies and run with some kind of power. It would seem that no dairyman, who manufactures his own milk into butter, having ten cows or more, could afford to be without a separator. One, if properly cared for, will last for years. If they are turned by hand, it is true that takes time, but not as much time as would be taken in setting and skimming the milk and warming it for calves. All except the smallest size hand separators are so constructed that they can be attached to a power. Some use a small gasoline engine, or some other kind. A light tread power run by a large dog or some other animal of like size is very economical. A goat has been found to do remarkably well.

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On the farm of the writer a separator has been run for the past five years, making an average of nearly 9,000 pounds of butter a year. The cost of repairs in that time has been $3, and the separator, to all appearance, will last for several years to come. It has a capacity of 300 pounds of milk an hour. It is run by a two-horse tread-power, which was purchased before the separator was, and which is used for cutting feed, filling silo, etc. The power is run by a Jersey bull, and works very nicely. He needs the exercise; it keeps him docile and gentle, vigorous and healthy, and he seems to enjoy the walking and work. The separating is done while the milking is going on, and ten or fifteen minutes after the last cow is milked the calves and pigs have had the new, warm, sweet skim-milk. The saving by the use of the separator on this farm has been already a great many times more than the cost of the outfit.

RIPENING CREAM.

When shallow setting has been used the cream is already ripened, or partially so, when taken off. It has been kept cool, stirred up when each skimming was added, and is ready to churn at any time when brought to the proper temperature.

A correct dairy thermometer is indispensable in butter-making. Temperature plays an important part all the way through. It is necessary to know the temperature of the dairy room, the water, the milk, the cream when ripening, and, above all, the temperature of the cream at time of churning. No person can guess at temperature correctly every time: therefore, no person can make a uniform quality of butter without using a thermometer at almost every stage of the work. Yet a cheap, unreliable thermometer is worse than none.

Cream from deep cold-setting is cold and sweet when taken off. If it is kept in a room where the temperature is about 60 degrees F. for twenty-four to thirty-six hours it will begin to sour. Each skimming when put in the cream can should be well mixed with what was in before. No fresh cream should be put in the can for twelve to sixteen hours before churning, for if this is done the fresh cream will not be ripened and the butter will not all churn out.

Cream from the separator is warm when it is separated right after milki and has the "animal heat" still in it. It must be aerated and cooled immediately. When the cream is run into "shot-gun" cans the aeration and partial cooling may be done by pouring several times in a small stream from one can to another. A better way is to have a cream cooler, made something like a large colander, placed high above the cream can. The bottom of this cooler has a great number of very small holes through which the cream runs in tiny streams into the cream can, and in that way is thoroughly aired and partially cooled. Setting in cold water will complete the cooling. Afterwards it can be handled the same as described for cold-setting cream, except that, being fresher, this cream needs about twelve hours more time to ripen.

The way just described is practiced by a great many with excellent results; but there is a better way if one has the facilities for doing it. Keep the cream by setting in small cans in cold water, or otherwise, at a temperature of 50 degrees F. till twelve hours before the time of churning. Then mix it all together in a vat or can and warm it up to 70 degrees F. Then put in a "starter" and keep it nearly, if not quite, up to 70 degrees for twelve hours, and when it is afterwards cooled to the right temperature it will be ready for churning. The starter may be some good skim-milk which has been kept at a temperature of 85 degrees or 90 degrees F. till it is sour and thick, or it may be some cream already ripened, or some buttermilk from the last churning. Use of the starter an amount equal to about 2 per cent. in bulk of the cream; in other words, one quart of the starter to twelve gallons of cream. Another form of home-made "starter" that has been highly recommended is made as follows:—Take fresh milk, secured in a perfectly clean way, from a healthy, well-fed, fresh milch cow. Set this milk in ice-water and expose only to pure air for twelve hours, or pass it through a separator, and keep the

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skim-milk at a temperature of 85 degrees F., long enough to lopper. Do not disturb the coagulum until ready for use. Then skim off the top, stir it carefully, and strain through a fine mesh into the cream, in the proportion already stated.

One of the most difficult things to determine is when the cream has the proper ripeness to be churned, so that uniform results can be obtained and one churning be like another. For aid in this respect acid tests have been invented for testing the acidity of cream during ripening "to trace the progress of its souring and show whether the fermentation should be hastened or checked in order to have the cream in a certain acid condition and ready for churning at a given time." These acid tests require experience and skill for their successful use. A skillful and experienced buttermaker is able to judge closely as to the right condition of cream for churning by its appearance. But this is a matter which it is impossible to exactly describe in words.

THE CHURN.

The best churns are those with no inside fixtures and which revolve, like the barrel churn, square-box churn, rectangular churn, etc. These "bring" the butter by the concussion of the cream in falling from one side to the other as the churn is revolved. A quite common mistake is to get too small a churn. It should never be filled more than half full of cream. One-third full is better, because the cream has a better chance to fall. Before putting in the cream the churn should be scalded with hot water and then rinsed with cold water.

CHURNING.

The cream should be brought to the right temperature for churning before being put in the churn by having it surrounded by cold water if the temperature needs to be lowered, and hot water if it needs to be raised. The churning should be done at as low a temperature as possible, and have the "butter come" in a reasonable time, say from thirty to sixty minutes. The colder it is churned the less butter-fat will be left in the buttermilk, and the more perfect will be the granules of butter. It is impossible to lay down any exact rule as to the right temperature; that will have to be determined by trial, each buttermaker for himself. Ordinarily from 58 degrees to 62 degrees F. is right, but sometimes it needs to be much lower and sometimes possibly a little higher. At the dairy tests at the World's Fair, in 1893, where expert butter-makers made every effort possible to do exhaustive work, the Guernsey cream was churned at times as low as 43 degrees, while the cream from the other herds was churned 8 degrees to 10 degrees F. higher. The temperature at which cream should be churned depends in some degree on the breed of cows, the individuality of certain cows or of certain families of cows, the period of lactation, the feed of the cows, and, more than anything else, the thickness or richness of the cream. The temperature of churning needs to be higher when cows are in an advanced stage of lactation; also when they have dry feed in winter, and when cotton-seed meal is being fed to any extent. When cream is rich in butter-fat, such as can and ought to be obtained with the separator, containing from 30 to 35 per cent. of fat, the temperature of churning can be low, usually from 52 degrees to 55 degrees F. This is the way to get the most exhaustive churning; the amount of buttermilk and the per cent. of butter-fat in it will be small at these low temperature. With deep cold-setting the cream will be much thinner, containing considerable milk, and therefore the per cent. of butter-fat low, and it will be useless to try to churn at a low temperatures. With deep cold-setting the to 62 degrees will be necessary.

Cream from shallow setting, if it is skimmed pretty clear of milk, can be churned at a somewhat lower temperature than that from deep setting. Sometimes the cream from shallow setting, especially if the process of heating and cooling has been resorted to in raising the cream, is so thick that it will not fall when the churn is revolved. In that case it must be diluted. Water is better than milk to dilute it with.

The churn should be revolved at a speed that will produce the best concussion. With a 40-gallon box or barrel

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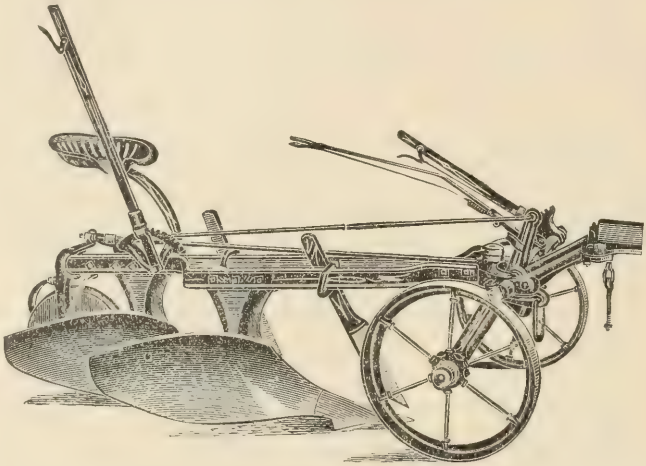

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churn this will be about fifty revolutions per minute; with a smaller churn somewhat more speed is required. One can soon learn to tell by the sound when the cream begins to break. Then close watching is needed, so as not to churn it too much. The churn should be stopped when the granules of butter are somewhat smaller than wheat kernels. To make the butter float well, so that the buttermilk can be drawn off, throw in some salt, say one pint to each 20 gallons in the churn. Then revolve the churn a few times. Draw off the buttermilk through a hair sieve, so as to catch the granules of butter that escape from the churn. Then wash the butter with pure water, at a temperature of 50 degrees or below. This will harden the granules so they will not so quickly mass together. Wash it twice, each time using ten or twelve quarts water to every 20 pounds of butter, and revolve the churn a few times. Do not wash it more, nor let the water stay on a great while at a time, for this will be likely to wash out the flavor and aroma, for which fine butter is prized.

The writer is well aware that this is contrary to the instructions given by many teachers on this subject. They advise washing more, saying that it should be washed till the water runs clear. But numerous experiments, where the butter has been submitted to the judgment of experts, seem to prove conclusively that the market yet demands some of the flavor that is found in butter which has not been excessively washed.

WHITE SPECKS IN BUTTER.

Mottles in butter and "white specks" are sometimes confounded, and by some are considered the same, but there is a difference. Mottled or streaky butter has been explained as being caused by an unequal distribution of salt; but "white specks" have a different cause or causes. Sometimes, when the milk is set in shallow pans, they result from the cream drying on top, so there are small portions that are so hard they do not churn into butter. These particles do not take the color like the rest of the butter, and the "specks" are thus caused. This may be remedied by carefully straining the cream when it is put into the churn.

Another cause of "white specks" is this: When some milk is skimmed off with the cream, as is usually done in the case of deep cold-setting, this milk settles to the bottom, gets overripe, and forms a curd, which will be so hard as not to break up in churning, and will not run off with the buttermilk, but will remain with the butter as "white specks," or "flecks," as they are sometimes called. This can be remedied by not letting the cream stand so long before churning, or by frequent and thorough stirring of the cream during the process of ripening. These hard, white particles can also be taken out by straining the cream.

Mottled, streaked or speckled butter will not sell well in market; therefore it is the part of wisdom to guard against such conditions.

COLORING BUTTER.

Butter should be colored to suit the person for whom it is intended. The general market demands that butter should have a color, the year round, about like that of grass butter in June. Doubtless any of the standard butter colors are good. The coloring matter should be put in the cream after it is all ready for the churn. When the butter would be nearly white if not colored, as is often the case in winter, about a teaspoonful of color is usually needed for eight pounds of butter. In summer, in times of drought, and in the fall, when cows are partly on dry feed, some coloring may be needed, but very little. One will soon learn by experience how much to use. It is well to be cautious, as it is better to have too little color than too much.

SALTING AND WORKING BUTTER.

Good, fine dairy salt should be used, and never the common coarse barrel salt that is used by many. The salting may be done in the churn when the butter is in the granular form, if it is a box or barrel churn. The salt can be sifted on the butter by putting on a part, then revolving the churn halfway over, thus making the butter fall with the salted side down, then sifting on the rest of the salt. Then revolve the churn a few times, after which the butter can be taken out and worked on a butter-

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worker. This is the way most commonly done, but it has its difficulties. The trouble is to have just the right amount of salt in the butter when it is finished, so as to have the product perfectly uniform as to saltness. The exact weight of the butter in the churn is not known, though this can be closely estimated, but it is impossible to tell how much water the butter contains, while in its granular state. This water must be all salted, and a portion of it will run off in the form of brine when the butter is worked. The finished butter should contain about three-fifths of an ounce of salt to the pound. To insure that amount, at least an ounce and a half of salt must be put in for each pound of butter in the churn, and yet, do the best we can, it will be found that two successive churnings are seldom salted just alike.

The writer has found that a better way to insure uniform salting is to take the butter out of the churn, drain and press out a part of the water on the worker, then weigh the butter, and salt one ounce to the pound and work enough to get the salt evenly incorporated. Some more water or brine will run off in the working and leave the butter salted about right. In this way it will be found that one churning will be salted very nearly like every other churning.

There are several different kinds of butter-workers used by dairymen, but in the opinion of the writer none are better for home use than the common lever pattern.

SHALL BUTTER BE WORKED ONCE OR TWICE?

The object of working butter is to get the salt evenly distributed and to expel a portion of the brine. When it is worked but once, the butter-maker thinks he has worked the butter enough and packs it immediately. There is, at that time, no way to tell whether the salt has been evenly distributed or not. A few hours afterwards he draws out some of the butter with a trier, or cuts it with a ladle, and finds it mottled, which will seriously affect the selling price. He knows the cause is unequal salting; that the portions which have salt have changed to a deeper yellow, and the unsalted portions have remained of a lighter color. With the next churning he is determined to remedy this, and be sure to work enough. The chances are that this time it is worked too much, so that the grain is injured and the butter has a greasy appearance. But after much practice and the exercise of good judgment and care, these errors can be avoided to a great extent, and a fairly uniform and even product produced.

In the opinion of the writer it is better to work butter twice instead of only once. The first time it should be worked just enough to mix in the salt. Then for four or six hours it should be left on the worker, or in some other place, where the temperature is from 60 degrees to 65 degrees F., so that the butter will remain in the right condition as to hardness to work well. This will give time for the salt to dissolve and also time for it to change the color of the butter it comes in contact with. Then it should be worked just enough to obliterate the streaks and mottles. This second working expels some more of the water, for the salt has had time to draw the moisture together in drops, and it is worked out, thus making a drier butter, containing from 85 to 87 per cent. of butter-fat. Such butter will firmer and better and more satisfactory to the consumer than it usually is when worked but once. Immediately after the butter is worked, it should be packed in neat, clean packages, or put up in such form as is required by the market to which it is to be sent. If tubs are to be used, ash or spruce is to be preferred, and they should be well soaked before packing the butter. If other wooden packages are used they should be lined with parchment paper. This will prevent the butter tasting of the wood.

MAKE BUTTER TO SUIT THE CONSUMER.

One thing should always be borne in mind by the person who is making butter to sell. The butter is for somebody else to eat, and it is for your interest to make it to suit them, whether it just suits your taste or not. Habit has a great deal to do with our likes and dislikes. You may have been accustomed

to sweet-cream butter; if so, you probably like that best. Or, you may have got used to eating butter made from very ripe cream, and the butter not washed to expel the buttermilk, causing it to have a very decided flavor and taste, and so you look upon fine, delicate-flavored butter as insipid. Or you may like little or no salting or high salting; light color or high color. But all this is of no consequence. It is no matter what you like. You want to make it to suit your customer, and you want your customers to be those who are able and willing to pay a good price for what suits them. If the customer wants sweet-cream butter, make it; if unsalted, make it so; if he desires it high salted, salt it high, and so on. Always make it the same for the same customers. They are getting tastes formed which you can make it profitable to gratify. It is not the province of the maker of dairy butter to try and educate the tastes of people who buy butter, but rather to cater to their tastes when he finds out what they are. If one is making butter to put on the general market, he wants to make what that market demands, and will pay the best price for. The best way to learn the market demand is to have the butter inspected by an expert judge, who is a dealer, and knows what takes best in the market. Ask him to criticize it and tell you just what he thinks of it; and don't get angry at what he tells you, but try and profit by what he says. The object of this article is to help farmers to make such butter as the best paying customers in the general market demand.

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The Ontario Agricultural College

—BY—

C. C. JAMES, M.A.,

Deputy Minister of Agriculture, Ontario

On the 27th of June the statue of the first Lieutenant-Governor of Upper Canada was unveiled by the recently appointed Lieutenant-Governor of Ontario. One hundred and seven years have come and gone since Lt.-Col. John Graves Simcoe sailed away from the little town of York to which he had but recently transplanted the government from Newark. The speeches upon the occasion of the unveiling made fitting reference to Simcoe's qualities as a British soldier, to his statesmanship in establishing the first representative government of this Province, and to his keen interest in planning for the future development of her resources.

Connected with Simcoe's regime there was one act, which, though somewhat simple at the time, and overlooked by most writers of his career, has been productive of great benefit to this Province, and is the historic beginning of the institution that forms the subject of this sketch. Simcoe's first parliament met at Newark on the 17th September, and adjourned on the 15th October, 1792. Twelve days after the adjournment, the Lieutenant-Governor brought together at Newark a small group of representative men who organized the first agricultural society of Uupper Canada. The foresight of the man, and his interest in the people showed itself most clearly in this the first official organization outside of the legislative bodies provided for in the Constitutional Act of 1791. This agricultural society was the parent of a numerous and vigorous family. From it have come the four hundred agricultural societies of the present day, and a score of associations devoted to special lines of agricultural work. In it were to be found the first elements of our modern farmers' institutes, and it is not claiming too much to state that the Agricultural College and Experimental Farm at Guelph, which has become the cope stone of our agricultural structure, may be traced back directly to this common source.

In the year 1830 the agricultural societies had so increased in number and importance as to demand public recognition, and an Act was passed whereby they were brought under government control and given financial asistance. In 1846 representatives from these local societies formed the Provincial Agricultural Association, the first object of which was the holding of a Provincial fair. It might be mentioned as an appropriate coincidence that this first fair was held in the residence and on the grounds of the Lieutenant-Governor, southwest corner of Simcoe and King streets, Toronto.

Soon after the Provincial Association passed into the form of a Board or Bureau composed of members elected by the agricultural societies of the various districts, and then its work widened. Reference can be made here to only one of these new undertakings. The secretary, Mr. George Buckland, was accustomed to visit the various local societies to address them upon agricultural topics. The older graduates and professors of the University may remember that the Board established an educational course in connection with Toronto University, and that Mr. Buckland became the Professor of Agriculture. His experimental farm, to which the older men refer sometimes with a smile, was located about where the University athletic grounds now stand. In the roll of graduates (p. 149 you will find the modest list of nine men to whom diplomas were awarded "n

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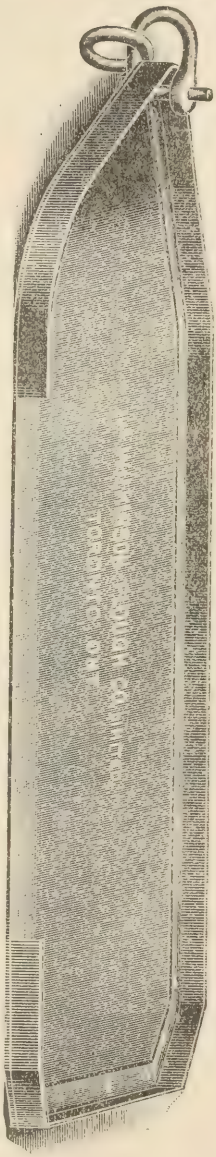
the years 1862-1873. You will not find many distinguished agriculturists among the noble nine. The experiment was not a brilliant success, but it contained the germ of our Agricultural College. To this same Board of Agriculture, the Ontario Veterinary College traces back; but that is another story that Dr. Andrew Smith can tell, for he was the young man brought out by the Board from Edinburgh to give instruction in Veterinary Science.

In the days of the old Parliament of Canada (1841-67), the sugestion of an agricultural school cropped up again and again, but nothing resulted, until the separation of the provinces, and the regime of the Sanfield Macdonald government began. In that government Hon. John Carling held the dual office of Commissioner of Public Works and of Agriculture, and the suggestions of earlier days were given new life by his appointing the late Rev. W. F. Clarke, editor of "The Canada Farmer," to prepare a report on the scope and nature of an agricultural school suitable for this Province. Mr. Clarke was a man of wide range, and, through his connection with the agricultural press, he was fairly well fitted for his task. He visited the two leading institutions of the United States (the State Agricultural College of Massachusetts and of Michigan) that were making a vigorous struggle for recognition. In due time the report appeared, and it may be found in the Sessional Papers of 1870. This report and the subsequent report of 1873 were no doubt somewhat startling to the doubting farmers and politicians of the day. In later years Mr. Clarke referred again and again to these reports with all the fondness of a proud parent, and we have often seen him "get up in meeting" and read from his production to prove how his comprehensive scheme had been worked up in some line or disregarded in some other. The result was that the Mimico farm was purchased, a few appointments made, and plans for building begun—when lo! the elections came on, the government fell, and the movement came to a sudden standstill. There had been criticisms of the location as a farm of thistles. There were also, I believe, some criticisms of the place as being too near to the city of Toronto and therefore presenting attractions to the young men from the farm that would not be conducive to good morals. The new government appointed a committee to investigate. It is interesting to recall that the present Minister of Agriculture was a member of that committee. Farmer members of the Legislature walked over the Mimico farm, two expert professors from the Michigan Agricultural College were called in, and soon after a report was presented to the new Commissioner, Hon. Archibald McKellar, in which the finding was that the Mimico site was unsuitable, and that a new farm should be purchased elsewhere in one of the most successful grain and live stock sections. Various farms were offered, but the selection was made of Moreton Lodge, near Guelph, the property of Mr. F. W. Stone. 550 acres of rolling land, a fine stone dwelling on a commanding site, with $74,500 as the price, were the main features of the transactions; but it finally required the aid of Her Majesty's constables to obtain possession. The forcible taking possession of the property by the government officers promised to become a great constitutional question, the point in dispute being whether officers of the Province had the power to act without special authorization from the county authorities. However, arrival of the cheque for purchase money soon smoothed away many difficulties. Then began on May 1st, 1874, the first course of lectures at the College, with 26 students, and a teaching staff of somewhat uncertain numbers, many classes being provided with occasional lecturers. The first move made by the pioneer band of students was to go on strike. A letter dated July 13th was sent to Premier Mowat protesting against the Principal, and stating they could not receive instruction from a "man so regardless of truth and so incapable of performing the duties assigned to him at this Institution." One week was the limit set by the students, and there were two days yet lacking when the Principal's resignation went forward. So much for an inglorious start.

The direction of the institution then came into the charge of the rector of the school, Mr. William Johnston, a young man fresh from graduation at the University of Toronto. In April of the following year an Englishman, Mr. Charles Roberts, arrived to succeed the man who had failed, but Mr. Roberts soon resigned owing to ill health. When the school was



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first started in May, 1874, Rev. W. F. Clarke was appointed rector. He resigned, however, in the general mixup in July. Mr. Johnston succeeded him as rector in August. In 1875 Hon. S. C. Wood was Commissioner. Mr. Johnston had shown remarkable ability in trying times, and was now advanced to the position of President. At the same time the first professorial staff was provided to assist the President, consisting of Professor William Brown (Agriculture), Professor E. A. Grange (Veterinary Science), and Dr. Baptie (Chemistry).

President Johnston held the place until 1879, when he resigned, and was succeeded by Mr. James Mills, M.A., the Principal of the Brantford Collegiate Institute. Dr. Mills has occupied this important position for twenty-four years, and has seen the institution grow through many vicissitudes. He has done more than see it grow, he has made it grow, for his life and the life of the institution that he has served so well are inseparably interwoven. In 1879 the teaching staff consisted of seven professors, and 162 students were enrolled; in 1902 the staff numbered 22 and no less than 768 students were enrolled in all the courses. This is a growth of which any educational institution would feel proud and justifies the liberal increase in grants made by the Ontario Legislature.

The large increase in the number of students in recent years is owing partly to the fact that the course of study has been enlarged from a two years' course (with diploma) to a four years' course (with a degree) and also to the addition from time to time of special courses in Dairying, Domestic Science, Poultry Management, and Live Stock Judging. At the same time the attendance in the general course has steadily increased, being limited in recent years only by the accommodation. In 1902, 290 students took the general course.

In 1888 for the first time the College enlarged its scope of work, and provided a third year's course. For some years before that time this addition had been suggested and discussed. The writer of this paper was appointed Professor of Chemistry in 1886, and shortly after one of the associate students asked for permission to continue his work in the laboratory beyond the second year. This was granted, and soon a second wished to do some special work along the same line. The time seemed ripe, a regular course was drawn up by the staff, and affiliation arranged with the University of Toronto. The class of 1888 numbered five and to them the Provincial University granted the first degrees of Bachelor of the Science of Agriculture (B.S.A.) in October, 1888. The course has been lengthened to four years, and year by year the College has sent up its students to the University examinations.

Most of the students are unable to leave the farm for studies beyond the two years' course, which has, from the first, been the important work of the College. Diplomas have been issued to about five hundred in the general course, while fully as many have been issued for the special courses. The great majority of these ex-students are engaged in agricultural work in Ontario.

In the sixteen years (1888-1903) 139 students have passed their examinations, and received their degrees. An interesting article might be written on the careers of these 139 young men. They are to be found in responsible positions doing splendid work. Many of them are working out the problems of life on Ontario farms, one of them has occupied a seat in the Legislature, three of them are directing work in the Provincial Department of Agriculture, no less than 12 were on the staff of the Agricultural College in 1902, four are in the service of the Dominion Government, thirteen are filling professors' chairs in American agricultural colleges, several of them are managing large agricultural estates in Canada and the United States, and two are filling government positions even in far-away India and the Philippines. Through the press, on the platform, in practical farm life, in experimental work, along all lines of progressive agriculture in this country, the graduates and associates of the Ontario Agricultural College are to be found today. The college is best advertised by its students, and the University need never be ashamed of this portion of her family.

A word or two as to the Ontario Agricultural College and its equipment. It is not too much to say that the college and farm is the best all-round equipped institution of its kind in the world. There are European institutions with certain departments developed beyond

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anything to be found in America. There are United States Colleges with departments having a reputation beyond ours, but at Guelph the whole institution is equally advanced; every department is up to its requirements. No one man, no one branch stands out beyond the rest to give it a one-sided reputation. The result is that the student may pass through the Ontario Agricultural College with a first-class general training in all the lines of Agricultural Science.

Many proofs of the good repute of our College might be given—testimonials from American and European visitors. One example may be interesting here. In 1900 the Argentine government arranged to send north a small band of students to be trained in agricultural work. Two by two they were sent to various American colleges. By the end of the year there were eight at Guelph. In 1901 the number had increased to fourteen, and in 1902 the Argentine band numbered seventeen. It should be stated, to avoid misunderstanding, that these are all compelled to board out of the college, and, therefore, do not keep out any deserving Ontario students. This may serve to illustrate the saying that "the opinion of the foreigner to-day is what will be the opinion of history hereafter."

The cosmopolitan nature of the advanced classes may be seen from the following statement of the graduating class of June 12th, 1903. The class numbered fifteen, composed as follows: Ten from Ontario, one from New Brunswick, and one from each of the following countries: Jamaica, Mauritius, Asia Minor, and Argentine.

Another point worthy of record is that the institution has attracted the attention of our own people. Last year there was opened for the use of the students the magnificent Massey Hall and Library, the gift of the executors of the H. A. Massey estate, and there is now under way the construction of the two mammoth Macdonald buildings, the gift of Sir William Macdonald of Montreal, for the training of public school teachers in Agriculture and Nature Study, and of farmers' daughters in Domestic Science.

For many years the college struggled for the recognition of its worth, the approval of its work—it is now in full sunshine of prosperity and is doing a work of which this Province may well feel proud. It is not the least important or the least effective of the many colleges in affiliation with the University of Toronto.

Year	Staff	Students	
1874	?	25	College opened 1st May.
1875	4	32	Wm. Johnston, B.A., appointed Principal.
1879	5	102	Jas. Mills, M.A., appointed Principal.
1887	8	110	Chemical Laboratory built.
1888	8	131	First degrees B.S.A. (5).
1891	10	132	Convocation Hall and Gymnasium erected.
1892	10	159	Botanical Laboratory erected.
1893	12	246	Dairy School established.
1894	14	290	Poultry Department established.
1895	15	250	Experimental Bldg. and Bacteriological Laboratory erected.
1896	16	237	New Chemical Laboratory.
1901	19	359	Biological and Physics Laboratory erected; Massey Hall and Library donated.
1902	22	708	Live Stock courses started and Instruction Pavilion erected; Macdonald Buildings begun.

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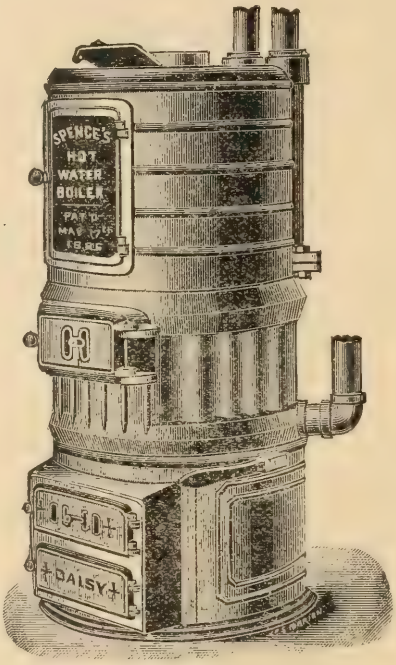

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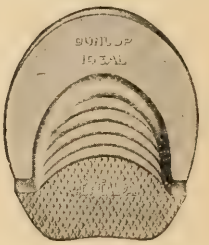

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Rossland, B. C.—Montreal.
Rossland, B. C.—British North America.
Rossland, B. C.—Royal.
Rossland, B. C.—Toronto.
Rossland—Commerce.
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Rosthern, N.W.T.—Br. North America.
Russell, M.—Union.

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Sarnia—Commerce.
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Sarnia—Montreal.
Saskatoon—Hamilton.
Saskatoon—Union.
Sault Ste. Marie—Commerce.
Sault Ste. Marie—Imperial.
Schomberg, O.—Traders.
Seaforth—Commerce.
Seaforth—Dominion.
Seattle—Commerce.
Selkirk, M.—Dominion.
Shawenegan Falls, Q.—Quebec.
Shawville—Merchants.
Shediac, N. B.—People's, Halifax.
Shelburne, Ont.—Union.
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Sherbrooke—La Banque Nationale.
Sherbrooke—D'Hochelaga.
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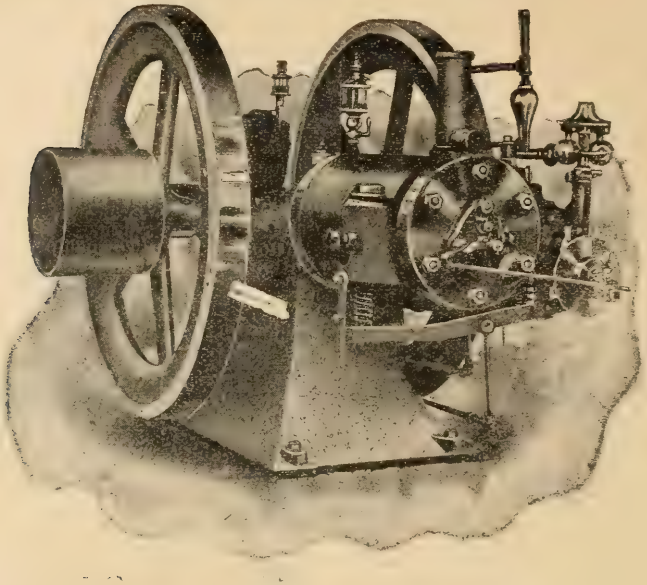

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—By—

C. C. JAMES

Deputy Minister of Agriculture, Ontario.

Why do we not educate doctors, lawyers, dentists, teachers and preachers in the same way that we do farmers?

Here is a young man who is going to be a doctor. We send him to a public school and teach him to read, write and make simple mathematical calculations - then we send him out to practise on people as best he can. He masters a few principles by helping some experienced doctor; he stumbles along and pickss up a few patients, keeping those who survive his experiments. Wheno he is approaching middle age we organize medical institutes, we send out some skilled physicians and surgeons who unfold to him for the first time the mysteries of his profession and who endeavor to interest him in the sciences underlying his art. We send him some valuable bulletins over which he labors and the secrets of which he but partially comprehends The doctor protests that he is treated in a most irational manner, a large part of his life has been wasted, he is now a man, his young manhood was neglected the time for this instruction has gone by. All this special training should have been given to him when he was in a receptive, teachable condition. Why did he not get this special training when he was younger? Why did he not have the science along with his art? Ah, well, you say, surely he should not complain—the method of training and education of our agriculturists should be good enough for the doctors. But it is not. The doctors say it people make the laws as they stand today. And so the medical profession has adopted its present line of training and education. Is it rational?

Here is a youth who intends to become a lawyer. As soon as he has mastered the three R's he says that he will set up his office, he will go to the courts, he will look for clients, he will work his profession simply by practising or by trying to practise. But the law steps in and puts up a barrier. His brother lawyers control him and his training. This young man must become trained in the law, he must study first and practise afterwards. It will not do to send him instructors when he becomes a man—he must become a lawyer while he is becoming a man. He must develop his mind in a legal mould. While he is growing and expanding, while his senses are keen, his memory retentive and his receptive powers are at their best he must learn the science of the law. All wrong you say, for surely we do not train the great mass of our farmers in that way. There must be something wrong somewhere. Are we unjust to the lawyers in our present exacting of this special training? There is a mistake being made either with the lawyers or with the farmers.

And what about the teachers? What do we mean by these model schools, these Normal Schools and Normal Colleges? The law says that the teacher must first receive special instruction in pedagogy—teachers must first be trained to teach and must be tested.

All through our mechanical operations the same principles are being introduced. Instruction along the special lines of their work must be given to men when young to be effective, to be productive of most benefit.

But when we come to agriculture how different it is! We have been saying to the young man who is to be a farmer, "Get a little education, just a little; then work yourself into a practical farmer and when you are full-grown, when you reach middle age, we will organize Institutes and send to you experts who will teach you the wonderful mysteries of your work. When your bodily strength is at its maximum, when your habits have become fixed and your mind has lost the keenness and curiosity of youth we will try to interest you in the science of your

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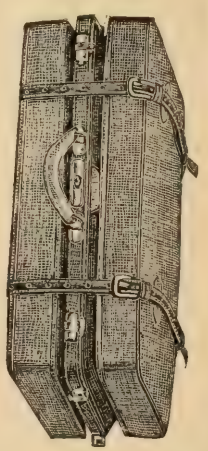

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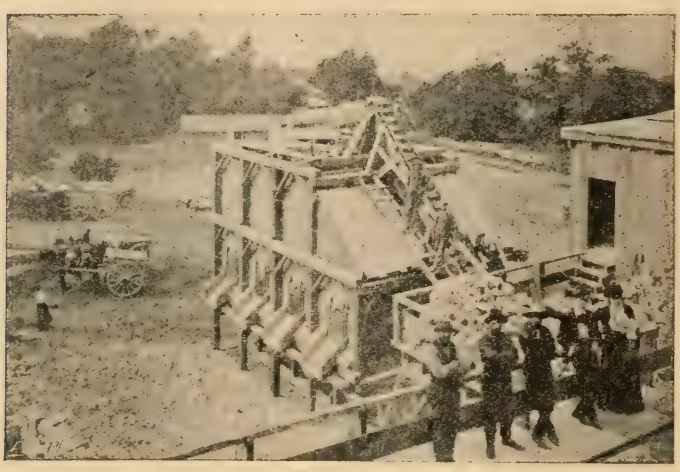
work. When you have lost much of the relish of reading we will send you bulletins to read, when you have become fixed and stable we will try to bend your inflexible nature into new forms." You heave a sigh and say: 'Ah, well, it's too late now—why did I not get this when I was younger, when I was inclined to study, when my expanding nature was ready to receive instruction." If only I were a young man again I could take all this in. I could profit by this instruction—it's too late now to do me all the good that is intended."

Some people wonder why the farmers are slow to move, why they do not more readliy adopt the teachings pointed out to them at Institutes and Conventions. Is it their fault altogether? Human nature is human nature, whether in agriculture orin professional life.

Is it not about time that we consider the proper training of the farmer to be as important a matter of national concern as the proper training of our professional men? If the education prescribed for our professional men is rational there must be something irrational in the training of our farmers. Institutes and Conventions are better far than nothing. Better to have reports and bulletins and addresses from matured farmers than none at all, but how much more effective all these would be if the men to whom they are addressed had received some preliminary training in the science as well as the art of their work. Some of the old countries of Europe have became thoroughly aroused to the importance of this question and there are signs here and there that in the newer lands of North America there is an awakening to the fact that to educate a farmer you must begin at the educative period. One dollar spent in instruction in the scientific principles of agriculture during youth will do more good than ten dollars spent on a farmer of mature years. Our present system is an attempt to move the great mass of agriculturists by working from the top downwards, but the trouble is we are always working on top, we do not get down. The only rational method, and the only way that promises sure and permanent success, is by beginning at the bottom. Is it not about time that we all, farmers and professional men, financiers and manufacturers, gave careful consideration to this question as to whether we are not working at this great problem of rural improvement from the wrong end?

GOOD ROADS



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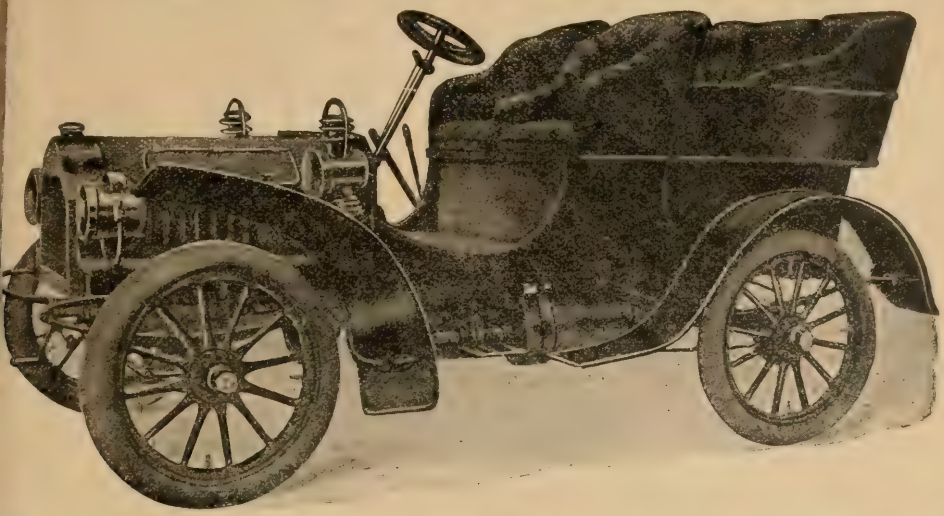

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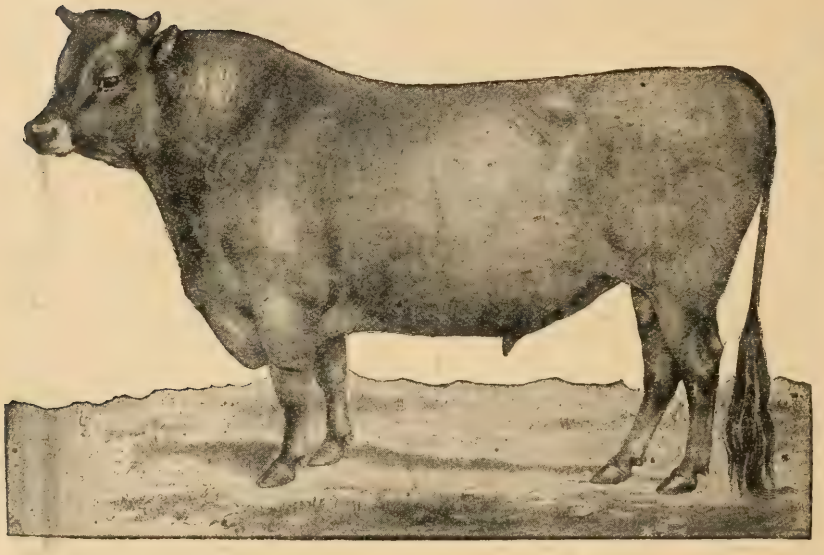

EXILE OF ST. LAMBERT, 13657.

THE above cut is from a photograph of the head of the Exile family, and the Exiles are known and recognized as the greatest butter family in existence.

Mr. B. V. Millidge, of St. John, N. B., has been very successful as an importer, breeder, and exibitor of this branch of the Jersey family. His first exhibit was in 1897, at the St. John Industrial, open competition, and at the St. John County Fair. His Exile of Willow Bank won first place at both shows. Since then the winnings of this herd have been continual.

In 1899, in open competition with stock imported from the Isle of Jersey, Mr. Millidge won first on best Jersey bull, and first on yearling Jersey heifer (see *Farmer's Advocate*, October 2nd, 1899, page 549; Mr. J. C. Snell, Judge). Last year (1902), at St. John Industrial, besides many other prizes. Mr. Millidge was awarded first for best Jersey cow on the grounds.

Prize-winning at St. John Industrial means a great deal, as all the principal herds of the Maritime Provinces and of the Province of Quebec are represented at that great show.

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Below we give a letter from Mr. Millidge, which is interesting reading for those interested in stock raising :

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ROCKLAND ROAD, ST. JOHN, N. B., May 6th, 1903.

GENTLEMEN :

I make a specialty of breeding Jersey cattle that have large, well-shaped udders, with large teats well placed, and heavy milkers. The Exiles seem to fill the bill. My trade is selling milk in the City of St. John, and selling bull calves to head dairy herds in all parts of the country. My calves are never vealed. I use Herbageum and have done so regularly for ten years, and would not think of raising calves without it. I feed it to horses, milch cows, young cattle, calves and poultry. I could describe a dozen cases where Herbageum has been of special benefit, but space would not admit of it. I will give one recent case. I imported from the United States last summer a three-months-old bull calf. It was bred in the purple, and I had paid a long price for it. I purchased it to breed to the grand-daughter of the great Exile of St. Lambert, and was very much disappointed with the calf when it arrived. It looked very miserable, and was scouring badly. I tried various remedies, with no good results I had, as I always have, a package of Herbageum on hand, and tried that. The scouring stopped at once, and the calf improved steadily from the first day He has been fed Herbageum regularly all winter, and gives promise of developing into a very valuable animal. I think he would have died from scours if I had not given him Herbageum.

I have always fed Herbageum to my Jersey cattle when preparing them for exhibition, and I have been very successful in the show ring.

My old stock bull is an inbread son of the greatest sire of milk and butter cows the world has ever known; his calves are never butchered by me, and when I sell them I am anxious that the new owners should take good care of them, as every one is an advertisement for my farm. I therefore always make it a point to advise every one to feed Herbageum. My stock are fed Herbageum nine months out of the year, and it pays me well to feed it to them. I have been offered all kinds of stock foods, but when I have a safe and sure thing in Herbageum I cannot afford to run the risk of experiments.

Yours truly,

B. V. MILLIDGE.

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INDEX

Agricultural College, Ontario 45
British Columbia 55
Executive Council 55

Dept. of Attorney-General 55
" Provincial Secretary 55
" of Treasurer 55
" Agriculture 55

Members of Legislature 56
Butter exports 82
Butter-making on the farm 117
Butter coloring 129
Cabinet of Dominion 25
Canada, Senate of 25
Climate of Manitoba and N.W.T. 58
Canadian trade increase 77
Cattle trade 82
Cheese, export of 82
Construction of silos 85
Culture of silage crops 87
Cheap seed 111
Creaming milk for butter 119
Churns and churning 127
Dominion of Canada 24

Dept. of Secretary of State 32
" Trade and Commerce 32
" Marine and Fisheries 32
" Inland Revenue 30
" Militia and Defence 31
" Finance 31
" Interior 37
" Indian Affairs 38
" Auditor-General 40
" Agriculture 40
" Railways and Canals 40
" Public Printer 41
" Public Works 41
" Justice 41
" Postoffice 41
" Customs 42
Dominion Lands Agents 37
Exports and imports 77
Expenditure per capita 80
Export trade 82-83
Eggs, export of 82
Effect of Lime on Soils 92
Enemies of Hessian fly 67
Feeding sheep 8
Feeding breeding ewes 8
Feeding in winter, ewes 8
Feeding rams 13
Fattening wether lambs 17
Fall breeding of ewes 11
Feeding lambs 14
Fly, Hessian 62
Finances of Dominion 78-79
Foreign trade 81
Filling the silos 89
Farm separator 123
Governor-General of Canada 24
Governor-General, staff of 25
Geological Survey Department 38
Grain exports 82
Good seed 102
House of Commons, officers 29
House of Commons, members 26
Hessian fly 62
How to secure good seed 109
Indian Agents 39-40
James, C. C., M.A., article on Ontario Agricultural College 133
Lamb-feeding for breeding 12
Lumber exports 82
Lining of soils 91
Lime, how and when to apply 96
Marine and Fisheries Department 32

Members of the House of Commons .. 26
Alc.-Bou. 26
Boy.-Hol. 27
Hug.-Oli. 28
Ose.-Wri. 29

Members Legislative Assembly of Ontario 53
Manitoba, Province of 53
Provincial Executive 53
Dept. of Education 53
Members of Legislature 53-54
Manitoba climate 58
Manurial action of lime 92
Milk for butter 117
Northwest Mounted Police 43
New Brunswick, Province. of 50
Executive Council 50
Secretary's office 51
Surveyor-General's Department .. 51
Agriculture Department 51
Board of Works 51
Nova Scotia, Province of 51
Executive Council 51
Crown Lands Department 51
Provincial Secretary 51
Agriculture Department 51
Public Works and Mines 51
Public Instruction 51
Northwest Territories 54
Executive Council 54
Members of Legislature 54
Officers of the Senate 26
Officers of the House of Commons .. 29
Ontario, Province of 43
Executive Council 43
Provincial Treasurer 44
Attorney-General 44
Public Works 44
Provincial Secretary 44
Crown Lands 45
Education Department 45
Agriculture 45
Members Legislative Assembly..46-47
Ontario Agricultural College 133
Privy Council Office 25
Prince Edward Island 52
Executive Council 52
Provincial Government officers .. 52
Members Legislative Assembly ... 52
Population of Canada 57
Population of principal cities 57
Poor seeds, protection from 102
Quebec, Province of 47
Executive Council 47
Colonization and Public Works .. 48
Secretary's Office 48
Lands, Mines and Fisheries 48
Crown Timber and Lands Agents. 48
Attorney-General 49
Treasury Department 49
Agriculture 49
Members Legislative Assembly .. 49
Ram feeding 13
Rape and pasture 16
Ripening cream 125
Sheep feeding 8
Shearing wether lambs 17
Staff of Governor-General 25
Senate of Canada 25
Aik.-God. 25
Hug.-Oli. 28
Osl.-Wri. 29
Secretary of State 32
Summer feeding of breeding ewes .. 11
Spring feeding of breeding ewes 11
Silos and silage 84
Soils, lining of 91
Seed, good, farmers' interest in 102
Sowing of wheat 73
Separator cream for farm 123
Salting butter 129
Trade and Commerce Department 32
Tests of seeds 118
Winter feeding of ewes 8

INDEX TO ADVERTISERS

Adams Bros., Toronto 150
Aylmer Iron Works Co., Aylmer 114
American Abell Engine & Thresher Co., Toronto 36
Battle, Estate of John, Thorold 140
Beechnut Bacon 138
Belleville Business College, Belleville 70
Bank of Hamilton, Hamilton 144
Beaver Manufacturing Co., Galt . 170 171
Canada Permanent Mortgage Corporation ..... Inside front cover
Canadian Casualty & Boiler Ins. Co., Toronto 86B
Consumers' Cordage Co., Montreal .. 118
Campbell, Arnott & Co., Toronto 122
De Laval Separator Co., Toronto 120
De Laval Separator Co., Toronto.... ..... Outside front cover
Dunlop Tire Co., Toronto 152
Dominion Motor & Machine Co., Toronto 156
Empire Cream Separator Co., Toronto 116
Eureka Planter Co., Windsor 126
Fleurys Sons, J., Aurora 176
Good Roads Machinery Co., Hamilton 164
Hamilton, Bank of, Hamilton 144
International Stock Food Co., Toronto 160
Kemp Manure Spreader Co., Stratford 134
London & Canadian Loan & Agency Co., Limited 1
London & Paris Exchange 158
Lawton Saw Co., St. John 110
Parker & Co., Toronto 168
Patterson Roofing Co. 169
Perrin Plow Co., Smith's Falls 128
Port Huron Engine & Thresher Co., Port Huron ..... Inside back cover
R. A. Lister Company, Montreal.... ..... 108A, 108B
Royal Military College 5
Rice Lewis & Son, Toronto 34
School of Practical Science 4
Spooner, Alonzo W. 76
Spramotor Co., London 112
Smart, Jas. Mfg Co., Brockville 132
Trunk and Leather Goods Co. 162
Tuerk Iron Works Co., Berlin 23
Tisdale Stable Fittings Co., Toronto. 124
Toronto Conservatory of Music, Toronto 106
Vermont Farm Machine Co., Bellows Falls, Vt. ..... Outside back cover
Wilkinson Plough Co., Toronto Junction 136
Westbourne School for Girls, Toronto 72
Warden, King & Son, Montreal 148
Waterous Engine Works Co., Brantford 86A
York County Loan & Savings Co., Toronto 130

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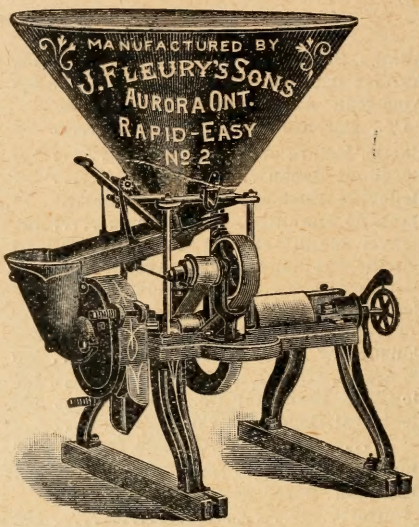

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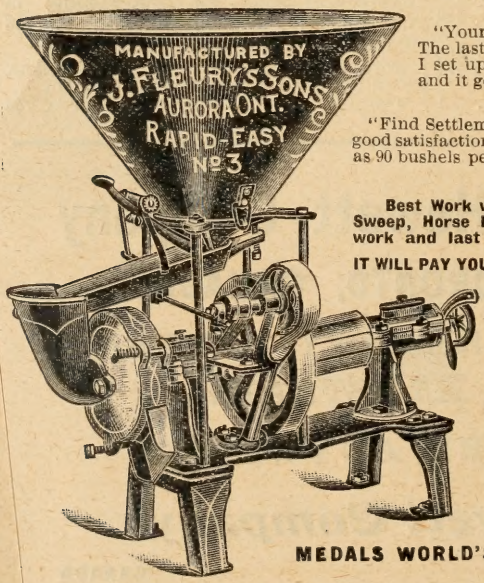

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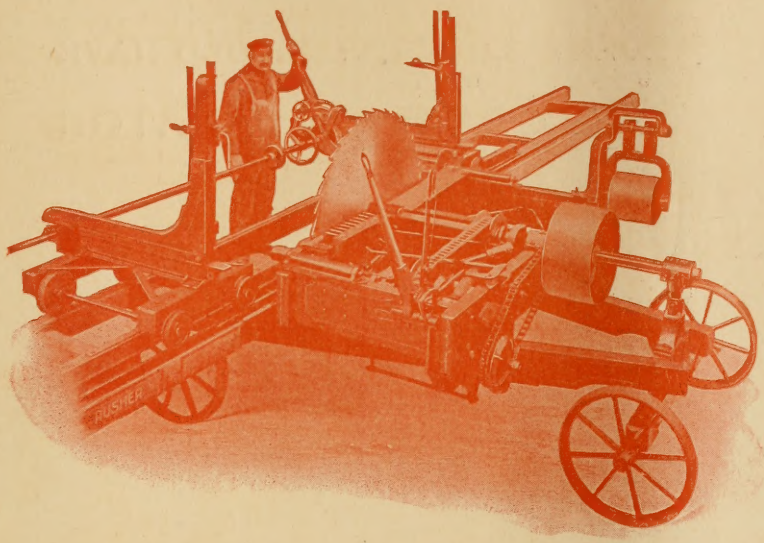

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